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The course design project was initiated for two reasons: (1) to discover why training courses generally are not designed or improved in accordance with seemingly obvious principles, and (2) to develop a systematic approach to course design that would result in the application of such principles. The major changes to be found in this revision concerned a criterion for stating on-the-job tasks which simplify the design process, greater emphasis on the role of tests in the feedback loop, a new point of view on the statement of objectives, and a general clarification of the steps in the design and redesign process. The 10 steps of the redesign process are: (1) state the course mission, (2) identify the tasks to be learned, (3) establish gross job entry standards for inventory tasks, (4) group the tasks for instructional planning purposes, (5) develop training exercises for each task, (6) state tentative end-of-course objectives, (7) develop lesson plans, (8) integrate lesson plans within and across instructional units, (9) conduct course and evaluate attainment of end-of-course objectives, and (10) improve the course. (CH)

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COURSE DESIGN AND REDESIGN MANUAL FOR JOB TRAINING COURSES (FIRST EDITION)

Edward A. Rundquist,
Navy Training Research Laboratory
in cooperation with
Commander Training Command,
U. S. Pacific Fleet

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COURSE DESIGN AND REDESIGN MANUAL FOR JOB TRAINING COURSES
(FIRST EDITION)

by

Edward A. Rundquist

NAVY TRAINING RESEARCH LABORATORY

in cooperation with

COMMANDER TRAINING COMMAND
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FOREWORD

This is a revision of the Navy Training Research Laboratory (NTRL) preliminary edition of a manual for designing and improving (i.e., redesigning) training courses. The revision is based on both a research and development program concerned with instructional design and on problems encountered by the Commander, Training Command, U. S. Pacific Fleet (COMTRAPAC) in implementing the new course design procedures. The revision is presented at this time because a marked clarification of the procedure has been achieved.

The major changes to be found in this revision concern (1) a criterion for stating on-the-job tasks which simplifies the design process, (2) greater emphasis on the role of tests in the feedback loop, (3) a new point of view on the statement of objectives, and (4) a general clarification of the steps in the design and redesign process.

The course design project was initiated for two reasons: (1) to discover why training courses generally were not designed or improved in accordance with such seemingly obvious principles as: content should be job related, objectives should be clear to both instructor and students, the student should be made aware of his progress, and instructional method should be related to and evaluated in terms of how well students meet the course objectives; and (2) to develop a systematic approach to course design that would result in the application of such principles. A third has been added--to determine which parts of the course design procedure typical Navy instructors need technical assistance to achieve and how this can be best provided by Navy training management. The course design project started with the design, or better, the redesign, of a CICWO course in order to acquire first-hand experience with the problems which confront instructors and instructional managers.

Work on the problem of course design early made it clear that there did not exist one complete source of information concerning all the steps of course design, written in the light of modern training technology. One can find writings concerning task analysis, its importance and suggestions for doing it; one can find descriptions of how to state objectives and how to discover whether they are achieved; one can find occasional descriptions of how methods of instruction are developed; but, to the knowledge of the writer, there is not available a complete account of the course design process as it looks to the course designer and instructor. Such questions as how to get from a set of technically perfect objectives, assuming one were sufficiently fortunate to have it, to the method of instruction and organization of lesson plans, and scheduling of the course are rarely discussed. One can, it is true, find very general discussions and outlines of what to do, some containing an overall statement regarding the course design process, but no account which really grapples with the operational steps involved. Special effort has been made to put the procedures described in this Manual in terms of the instructor's point of view.

Because of the needs of COMTRAPAC, the Manual is being written as a series of revisions rather than waiting until a relatively definitive edition can be produced. The preliminary edition, like the first attempt to teach a new course, had many flaws. With the feedback obtained from continued attempts to apply the procedure (analogous to the use of tests for the purpose of improving instruction in the course design process) many improvements have been achieved, involving in the case of stating the standards for objectives a marked shift in point of view. While it is believed major improvements in the procedure are described in this first edition, it no doubt can still stand improvement. Suggestions for revision will be welcome and are strongly invited.

Two points have become abundantly clear from the NTRL project: first, good training course design is an arduous and time-consuming process. The fact that it requires such hard and detailed effort is one major reason why procedures considered most adequate are not widely followed. Second, the Navy training management system needs modification to provide the support necessary for developing and conducting training courses in accordance with modern training technology.

Two additional points have become clear from COMTRAPAC's experience in implementing the procedure described in this Manual. The first is the difficulty of getting across the concepts of the elements of an objective. Vague objectives like "The trainee will have a thorough working knowledge of the system" and ". . . will demonstrate proficiency in preparing the required reports," continue to be submitted. Second, misunderstanding concerning the nature of standards for objectives continues: for example, completely meaningless standards like "achieving a score of 90 per cent on the examination," are frequently stated. The misunderstanding concerning standards is understandable as the discussion in the present edition of the Manual shows. Less understandable is the continued difficulty of getting across the point that objectives should be stated in terms of the tasks to be done--energize a radar, monitor a radar operator, compute a CPA on a radar scope, type a letter, solder a connection to a terminal lug, and so forth. This revision of the Manual has made a particular attempt to clarify these points.

Because course design is a complex process, a manual describing it is also complex. After careful reading and study, this Manual will be best used as a reference to specific sections at appropriate times in the course design process. The Manual is written in terms of the redesign of a very complex course. It is expected that the application of the procedure to courses of less complexity than the one used for purposes of illustration in this Manual will be easier than the application described herein.

While course design is a complex process, most of the principles, taken one at a time, are simple. What seems to be difficult is the understanding of the total procedure as a unit so that one can see the relationships of one step to another. If the instructor will carefully study the diagram of the procedure (Fig. 1) in relation to the overview of the process given in the introduction and keep it in front of him as he reads the Manual, it will help in understanding the detail under the several steps. Fig. 1 has been placed on a fold-out page on page 47 to make this possible.

Because course design and redesign is so complex, the instructor cannot always expect to complete the process for a course during a single school assignment. He can expect to begin the job properly, so that when he turns the course over to his successor, the successor can carry on where he left off. Navy training management must expect that complete course overhaul in accordance with the principles and steps in this Manual must be accomplished over an extended period of time.

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COURSE DESIGN MANUAL FOR JOB TRAINING COURSES
(FIRST EDITION)

INTRODUCTION

Purpose of Manual

A group of well qualified subject matter experts, working with a group knowledgable about principles of learning and course design, can usually come up with a course in which the content is relevant and complete, and in which good teaching methods are used in the context of a good course organization for instructional purposes. A committee of such experts will keep all the necessary principles in mind while they proceed more or less systematically.

The NTRL design of an experimental course for electronic technicians is a good example of this procedure (Pickering & Anderson, 1966). The committee first systematically developed a list of job tasks, classified them under the general areas of preventive maintenance, corrective maintenance, use of test equipments, use of reference materials etc.; and under each heading developed a set of general objectives. Then, keeping training principles in mind, a set of headings for lesson plans were developed to train for these tasks; for each lesson plan, objectives were stated and plans developed to achieve these objectives. Where did the list of general objectives come from? How was the list of lesson plan headings developed; why were they arranged in a particular order? What were the considerations in getting from the list of general objectives to the highly specific objectives of the lesson plans? The present Manual can be regarded as an attempt to identify the course design steps practiced by such experts and to systematize them in such a way that appropriate principles of learning and organization of course content are considered by typical Navy instructors at the right time.

The general purpose of this Manual is oriented to such questions as given above to provide guidance for instructors and instructional managers in fulfilling their course design and course improvement (redesign) responsibilities. More specifically, the objectives of this Manual are to describe (1) the steps in the course design and redesign process and (2) ways to accomplish these steps. The Manual is directed toward courses which provide job-training and not toward educational, or cultural or minor orientation courses. The procedures described in this Manual do apply to all job-related courses, whether they are concerned with operator, technical, intellectual, operational, supervisory or leadership skills. They apply to introductory or refresher courses concerned with providing training in fundamental doctrine, in providing knowledge of the broad concepts and objectives or a minimum understanding of particular kinds of warfare. All such courses are providing information for purposes of use somewhere, sometime; and the manner in which the information is used is the test of the effectiveness of the course. All such courses should provide the information in the contex of its use and whenever possible provide exercises for the use of the information. If, on analysis, no job or duty assignment use can be found for information being taught, it should be eliminated from the course. If a course contains a lot of such information, it probably should be abolished.

The Course Design Process

Course design for job-training may be defined as the derivation and development of a specified set of training objectives and the selection and organization of instructional material for efficient attainment of this set of training objectives. Objectives are customarily defined in terms of three elements--the behavior the student is expected to demonstrate at the end of the course, the conditions under which he is expected to demonstrate the behavior, and the standards at which the behavior is to be demonstrated. The standards are typically illustrated in quantitative terms, e.g., solve three of four problems correctly.

This is a statement of standards in terms of the tests given. A more concise statement of three illustrative objectives given in the preliminary edition of this Manual can serve as the basis for illustrating a marked change in point of view concerning the statement of objectives.

1. Type with no more than one typographical and no format error a standard 250-word letter containing two addressees and one information addressee, with correct number and color of copies (Use of the Navy Correspondence Manual, typewriter eraser and shield is permitted).[1]

2. Convert written 1-4 digit decimal numbers to binary numbers, perform the four arithmetic operations on the latter as directed, and convert answers back to decimal numbers, showing all work. Three of four problems for each arithmetic operation are to be correct. No error allowed in procedures.

3. Connect and solder a wire to a terminal lug with neat crimping, cutting and bending, to

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[1] Similar examples of objectives and a discussion on preparing them can be found in NAVPERS 93510, Handbook for Writing Learning Objectives. This Manual is intended to be corollary to and a logical extension of the Handbook.

> stand pull and current flow tests, choosing correct solder and soldering iron.[2]

Under certain circumstances the behavior element can serve the purpose of a completely stated objective, e.g.:

1. Type a standard Navy letter.
2. Perform the four arithmetic operations with binary equivalents of 1-4 digit decimal numbers.
3. Connect and solder a wire to a terminal lug.

The circumstances when the behavior element can serve the purpose of the entire objective are when (1) the task to be learned is stated with a particular degree of specificity, (2) the objective contains sufficient information to serve its communication purposes, and (3) the detailed conditions and standards omitted from the above examples are contained in the lesson plan. The meaning of these provisos will become clear in the discussion of the several steps of the course improvement process.

Whatever the manner of stating objectives, a major question concerns the basic source of such objectives. For *job-training courses* it is a list of tasks comprising the job; for *educational courses* it is the intellectual skills needed to understand and deal with the subject matter. The development of objectives for job-training courses as though they were educational courses brings about major weaknesses in course design.

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[2] The objective given below, as stated in the preliminary edition of the Manual, contains 78 words as opposed to the 28 used here. The change is to emphasize the principle of stating objectives as concisely as possible.

Behavior: To connect and solder a wire to a terminal lug.

Conditions: In a classroom laboratory, given roll of insulated hook-up wire and a number of soldering irons and kinds of solder. Cut two-inch length of wire from roll and strip one-half inch of insulation from it. If damage wire, repeats until obtains an undamaged piece.

Standards: Cutting, crimping, and bending must be neat; proper solder and iron must be selected; solder joint must stand pull and current-flow tests.

For job-training courses a list of specific tasks performed on the job must be obtained. One source of such a list is the practical factors in the Manual of Qualifications for Advancement in Rating (NAVPERS 18068). If these tasks are representative, fully defined, and job oriented, they can be used as the basis for deriving course objectives. Unfortunately these practical qualifications are not always representative or stated with the degree of specificity desired.

For Naval officer duty assignments and billets, practical qualifications lists do not exist. A list of tasks to serve as the basis for deriving course objectives must, therefore, be developed from a systems analysis approach, from observation of qualified officers performing their job, from questionnaire surveys of job incumbents and their supervisors, by committees of job-knowledgable personnel or by a combination of these methods. When enlisted practical qualifications are not satisfactory, they will need supplementing and correction by the same approaches.

With a list of specific tasks at hand a basis has been achieved for selection of course content and of methods of instruction, for developing and organizing lesson plans, and for the formulation of objectives and evaluation of their attainment.

Many Navy courses have the mission of preparing non-career personnel for their initial assignments. The advantage of eliminating all irrelevant materials from courses for such personnel is obvious. Even when dealing with courses for career personnel, however, the same consideration should hold. This is not to say that an ETCM does not need to know considerable about electronic theory, but that the time he learns this should be in conjunction with the kind of job assignment he is undertaking. Much of what is taught in an educationally-oriented initial course emphasizing theory is long forgotten prior to an opportunity for its use.

Following good course design procedure more than compensates for the effort required because:

1. The training objectives increase the likelihood that the course stays on target. A set of well written objectives is communicable. Where there is instructor turnover, objectives will be found to prevent dilution of the course by adding "nice to know" content and subtracting relevant content.

2. The course steadily increases in efficiency. Students are highly likely to achieve the objectives in shorter times and with more effective instructional aids because instructors can concentrate on improving training methods.

3. The course is effective. The content is relevant and essential. Students acquire the knowledges and skills needed to attain the job-related objectives.

OVERVIEW OF STEPS IN COURSE DESIGN

Once the decision to have a job-training course has been made, the design of such courses can be discussed in terms of ten steps. While there is a rough ordering to these steps--i.e., development of a task inventory must come before determining the conditions of learning and the statement of objectives follow this, there may be variation in the order depending on the nature and complexity of the job to be learned. Further, there is sufficient interaction among the steps so the instructor will be thinking of several of them simultaneously; and he will sometimes find that he did not accomplish a step in the best manner to serve his purpose for a later step. He will then improve the accomplishment of the earlier step. The intimate relationship between the formulation of objectives and the actual instructional planning that will be observed as the steps are described makes the interaction inevitable. The manner and ease of application of each step and the extent and nature of the problems encountered in designing different courses can be expected to differ. It is the principles underlying the procedure that remain the same.

The ten steps are incorporated in a flow chart (Fig. 1, page 47) which shows the major interaction and feedback loops. Each step is briefly described below:

1. State the course mission. This step can be considered as defining the general objective for the course. It specifies the scope and establishes boundaries for the course content. It does this by identifying the situation and conditions under which the relevant tasks will be used and by stating the prerequisites for attendance. Although Step 1 is a management function of those commands charged with initiation and execution of courses, the instructor shares the responsibility because of his ability to recommend changes to improve the mission statement.

2. Identify the tasks to be learned. This step results in a list of on-the-job tasks toward which the training is oriented. This list is termed a Task Inventory and is the second step in controlling the content of the course. These tasks serve as the behavioral elements of the end-of-course objectives. The level of detail at which these tasks are stated is critical to a simplification of the procedure proposed in this edition of the Manual and in providing flexibility in instructional planning. A good task inventory is a must for it insures complete coverage of relevant content and the exclusion of the irrelevant. Without a good task inventory no training course can attain maximum effectiveness and efficiency.

3. Establish gross job-entry standards[3] for inventory tasks. This is the third step in controlling course content. Training to the level of proficiency of the experienced job incumbent is rarely undertaken in a single training course. This third step identifies which tasks need to be taught, and for these, which can be taught in terms of knowledge about the task and which must be taught in terms of practicing the task. For skills, it identifies gross standards of proficiency which should be attained by the student. Even this early step begins to make clear appropriate methods of instruction.

4. Group the tasks for instructional planning purposes. This step makes it possible to deal with small sets of tasks for instructional planning purposes. It groups the tasks under major instructional units or sections and within each of these, under tentative lesson plan headings or topics. It identifies basic skills or tool subjects (i.e., mathematics, theory of radar, etc.) common to more than one of the tasks and indicates which of these tool subjects is relevant to each instructional unit.

5. Develop training exercises for each task. This step determines which tasks are most appropriately taught by which general instructional method--reading assignments, supervised study, lecture, case study or other discussion method, programmed instruction, computer assisted instruction, laboratory demonstration or practice, special tutoring, and develops the practice exercises. The skill with which this step is done, and especially the skill with which exercises are developed, has a great deal to do with the success of the course. The thinking involved here serves as a major base for lesson planning.

6. State tentative end-of-course objectives. Step 2 identifies the behavioral elements of the objectives; Step 5, the exercises for achieving these behaviors; the present step develops the tests and the conditions associated with them. These can be put together in a complete objective. At this point, the objectives are tentative. It is the development of the tests that is the important feature of this step.

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[3] Job-entry standards are those levels of performance of tasks in the inventory the course graduate should possess when he starts his duty assignment or shipboard training for his duty assignment. If the training capability were such that the student could be realistically trained to these standards, job-entry standards and course graduate standards would be the same. Because equipment is frequently lacking to train to job-entry standards, it is necessary to differentiate between job-entry standards and course-graduate standards. Some courses prepare for entry to a succeeding course. Job-entry is used throughout to cover both contingencies simply for economy in writing.

7. Develop lesson plans. These are the detailed outlines to be followed in the instructional situation. A lesson plan tells what objectives are to be achieved, what the student will do, what the instructor will do, what materials will be needed, and how time will be allocated. Lesson plans are developed in terms of learning principles as well as in terms of the logic of the training content. At this point lesson plans are developed only in terms of logic based on these two requirements. Convenience for scheduling the course is not considered. Step 7 involves deriving subordinate tasks required to achieve the end-of-course objectives, and, when needed to pace the instruction, using these as the behavioral element of subordinate objectives; and adjusting assignment of objectives to lesson plans, organizing and sequencing the instruction, refining the statement of objectives, and preparing the lesson plans in detail.

8. Integrate lesson plans within and across instructional units. Once all individual lesson plans are developed, they must be integrated across instructional units. This integration must be primarily in terms of learning principles, although the logic of the content is involved. Once this integration has been achieved from the standpoint of learning principles and content, the instructor can look for points at which to divide the material for convenience in scheduling the course. The course schedule can then be made out.

9. Conduct course and evaluate attainment of end-of-course objectives. It is common knowledge that the first presentation of a course leaves much to be desired and leads to many modifications and, hopefully, to improvement. Conduct of the course is therefore part of course design. To replace the word "hopefully" in the sentence above with the word "certainly" is the purpose of evaluating student attainment of the objectives. The importance of instructors knowing with a good deal of precision what students are learning cannot be overemphasized for its value in insuring that change in the course is progress in redesigning the course.

10. Improve the course. This is essentially a feedback step. The basis for the improvement has been accomplished by Steps 6 and 9. Methods of instruction may need revision in terms of what the examinations have shown. The mission may need changing to make it clear and realistic. Time allotments may need revision. Conditions of training may need improvement. Course organization may need to be changed. In essence this step amounts to studying the results of the examinations for their implications for course redesign. Note th[illegible] tests are used primarily for instructional purposes and only secondarily if at all, for student evaluation; note too that student critiques are not used. Student critiques may be useful for identifying administrative procedures or bothersome instructor mannerisms that need changing, but not for instructional improvement. It is analysis of the results of testing student performance that accomplishes this.

While each of the ten steps has its place in the course design process, the real keys to course improvement are good tasks, good training exercises, and good tests.

COURSE REDESIGN

To improve a course is to redesign it and in the long run, course redesign must go through the same steps as course design. How much can be used from the current lesson plans depends entirely on how well the course was originally designed. In some instances one may as well discard most of what is available; in others little may need to be done to bring the course in line with the procedures and principles in this Manual.

The first target in course design is to determine whether the course content is relevant and complete. This is the purpose of the first three steps of the course design procedure: state the course mission, identify the tasks to be learned, and establish gross job-entry standards for inventory tasks. The reason for establishing relevance and completeness of course content as the first target stems from the fact that no improvement in method of instruction or in course organization, or in testing and applying the feedback step can result in any improvement in training, if the content is not relevant.

The mission of a current course should therefore be evaluated to determine whether it identifies who is to be trained, the billet or duty assignment conditions under which this training is to be used, and whether it is clearly interpretable and realistic in terms of the boundaries established for the course content. If the mission does not meet these requirements it should be stated so it does, and this statement recommended to appropriate management for adoption.

A task inventory (Step 2) should then be developed in terms of the criteria that each task can serve as the behavioral element of a single end-of-course objective. To the extent that the course has been designed in terms of on-the-job tasks, such tasks will appear in, or be directly implied by, the material in the lesson plans. These tasks can be pulled out, stated so that each can become the behavioral element of an objective, and grouped according to the subsystem and/or functional area to which it belongs or under some other series of job-oriented categories. It is believed that a grouping in terms of the categories of system analysis will in the long run be most useful.

The instructor can inspect the tasks for consistency with the course mission, eliminating those which are inconsistent, and adding any that have been omitted. This list of tasks can be checked with job-experienced people for additions and deletions to insure that the list represents an accurate statement of all of the tasks on the job or duty assignment encompassed by the mission, and contains no task which is irrelevant. In checking the list of the tasks, Step 3, the establishment of gross job-entry standards, could readily be accomplished at the same time.

Once a list of tasks is established, the instructor should examine his lesson plans to eliminate any content not related to a task and to assign tasks not previously taught to appropriate lesson plans. This may involve some reorganization of lesson plan content. What the instructor wants to achieve is a grouping of the tasks for instructional purposes, the identification of tool subjects, and a way to integrate their instruction with the task training, as described under Step 4. This will enable him to deal with one lesson plan and its tasks at a time.

Once the tentative organization is developed, the manner in which the instructor concentrates his effort for each lesson plan on the remainder of the steps, will depend primarily on how closely the content of each plan is related to the task or tasks to be taught. If it is not closely related to the tasks, the instructor should follow the steps of the original design procedure, namely, develop training exercises for the tasks (Step 5), develop tests and state tentative end-of-course objectives (Step 6), reorganize his lesson plan (Step 7) in terms of the logic of the subject matter and the learning principles described on pages 37 and 38.

Making the needed adjustments in each lesson plan, the plans can be integrated as described under Step 8. The instructor can then conduct the course, evaluate attainment of end-of-course objectives (Step 9), and improve the course by analyzing the test results in terms of time allotments, instructional methods, and so on (Step 10). In carrying out the above steps, the instructor should keep in mind that the points of major importance are the construction of exercises for task training, the construction of tests to measure attainment of the objectives, and the analysis of test results in terms of instructional procedures, time allotments and course organization.

The more closely lesson plan content (including exercises and tests) conforms to the requirements imposed by the tasks, the more flexibility the instructor has in the order of carrying out the steps of the course design procedure. He may wish to resequence the course to better conform to logic of the subject matter or to appropriate learning principles. It may turn out that exercises are adequate but tests are not. Hence, he will wish to concentrate on the tests. Or it may be that he will wish to concentrate on making possible the better adaptation of the course to individual differences in prior student experience. This flexibility, however, is a consequence of having the right tasks, good exercises, good tests targeted to well stated objectives. Without these, other adaptations can have only minimal effects.

STEP 1. COURSE MISSION

A course mission is a statement of the general objective for a course. It identifies who is to be trained and in what situation and under what conditions the training is to be used. The "who" is to be trained is a matter of specifying prerequisites for a course and is not considered in this Manual.

Specifying the situation--duty assignment, position, succeeding course--where, and the conditions under which the training is to be used, establishes the scope and boundaries of the course. Electronic Warfare (EW) training, for example, can cover a wide range of skills and knowledges. The course mission statement for an EW course should therefore specify whether the graduate is expected to use the EW knowledge and skills as an EW officer (EWO) on a carrier, as an electronic material officer (EMO) on a destroyer, or in some related position such as a task force commander. The mission for an EWO might be "to prepare a naval officer to supervise and monitor the operation of a carrier's electronic warfare equipment;" and the mission for a task force commander, "to prepare a naval officer to use electronic warfare concepts in task force tactics."

Other examples of mission statements:

1. To prepare a naval officer for rapid qualification as a CICWO on a combatant ship under normal steaming conditions. The constraints included in the above mission set boundaries which are both realistic and consistently interpretable as further defined below. Under this mission training in knowledge of and skill in using the ship's offensive and defensive capabilities will be eliminated. There will be no training in advanced AAW and ASW evaluation and weapon assignment. Without the constraints "combatant ship" and "normal steaming" on where the training is to be used, the mission could be interpreted to cover all tasks required of a CICWO in all evolutions under all conditions of readiness on all types of ship or a wide variety of combinations of these matters, depending on particular instructors' points of view. There is even a question whether the above mission is specific enough. "Normal steaming" is not intended to include condition III, a condition which is in fact now "normal" in certain areas of the world. Since the CICWO stands regular watch rotation during this heightened condition of readiness, either provision for on-the-job learning under supervision should be made or the course should be lengthened to take account of the greater amount of training that will be required.

2. To prepare students to perform under supervision the duties of a third-class Electronic Technician in FRAM II type destroyers. In this mission the constraints are "under supervision," "a third-class Electronic Technician," and "a FRAM II type destroyer." With these specifications, limits are placed on the amount of basic theory that is required and on the kind of equipments that are of concern.

At times the mission must be stated in terms of an arbitrarily set course length. For example, a possible mission for a course for senior naval officers in utilizing current tactical concepts in anti-air warfare, might be: To provide as much practice as is possible in a five-day course for senior officers in applying current AAW tactics in a task force situation for the duty assignments of COs, XOs, Operation Officers on CVAs, CGs, DDs, DLGs, and staff CICOs, EWOs, and AAWOs. The Task Force officer positions named provide the restrictions on the content to be included.

General courses in "fundamentals," "leadership," or "supervision" need further specification before content can be meaningfully derived. The application of any principles to these three areas requires different content and different emphasis in different contexts. Instruction will be more efficient and meaningful if missions are stated in terms of situations of application, for example: "To prepare a CPO to manage CIC enlisted personnel to promote efficiency and morale;" "to prepare a CPO to lead a landing party in a combat area;" "to prepare a CPO to manage enlisted personnel to maximize efficiency and morale in Polaris submarines." The training in leadership for the three situations will differ just as the amount of "fundamentals" will differ for electronic technicians and radar operators.

The test of whether a mission is well stated is simply whether the kind of personnel who are going to design the course, independently interpret it in similar fashion.

The statement of course mission is, under Navy procedure, a management responsibility. Practically speaking, the instructor shares the responsibility in that he can recommend changes in current missions and new missions for courses he believes should be designed. Unless missions are stated with sufficient constraints to make them consistently interpretable, all possibility of standardizing training in different schools, or even in the same school over time, is lost. Further, without provision to evaluate suggestions for inclusion of additional material in particular courses, training content in these courses tends to alter in the direction of the "nice to know" with consequent dilution of the emphasis on what the student must achieve.

STEP 2. THE TASK INVENTORY

The Task Inventory is a list of tasks performed on-the-job or duty assignment toward which the training is directed. These tasks often will be referred to as behaviors because they become the behavioral elements of the end-of-course objectives. Since such a list serves as the criterion for the relevance and completeness of course content, course design should not proceed until such a list is available.

The designer of every training course has in mind, at a minimum, a general notion of the tasks for which his course is designed and, at a maximum, has developed a systematically written list of precisely stated tasks. The problems concern, not the need for a task inventory, for this certainly is a necessity, but how it is developed, by whom, and to what level of detail.

Developing a Task Inventory

The critical points in developing a task inventory are that the task statements be (1) accurate, (2) complete, (3) unambiguous, and (4) nonoverlapping descriptions of what the job-incumbent actually does. The inventory must contain tasks specified at a level of detail which permits their use as the behavioral element of a single end-of-course objective for training for a particular duty assignment.

The emphasis in stating the task behavior should be on action verbs: calculate value of a current in a series-parallel direct current; type a standard Navy letter; connect and solder a wire to a terminal lug; perform arithmetic operations with binary numbers; energize a radar; monitor a surface search radar operator, detect an unsatisfactory radar presentation, code a message, select current inductors, identify the windings on a multi-cap transformer, test an inductor with a VOM for opens and shorts.

Probably the method most commonly used in the design of Navy courses is the committee method. The committee has two general choices of procedure: (1) it can rely on available lists of tasks, such as those in the Manual of Qualifications for Advancement in Rating, supplemented by the ability of the committee members to recall the tasks; or (2) it can take a more systematic approach such as systems analysis.[4] For complex positions or assignments a systems analysis approach has the advantage of insuring complete coverage and the exclusion of the irrelevant. This approach was therefore used in the development of the task inventory for the CICWO position. A system analysis approach is recommended for developing a task inventory for positions and assignments of such complexity.

A system is a group of man-machine components organized to achieve a particular purpose. Developing a task inventory from a systems point of view means looking at the job or assignment in the context of the system in which it is embedded, identifying the subsystems, then the functions, the task areas, and finally the tasks or operational steps suitable for the purpose at hand.[5] These steps in the process will be illustrated by the development of the Task Inventory for the CICWO position.

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[4] The results of a systems analysis may be available. While these may be helpful, it is unlikely that they can be accepted at face value for purposes of constructing a task inventory for training purposes. This is because the manner in which the tasks are stated varies for different purposes.

The first step in the development of a task inventory for this position was to identify the system in which the CICWO position is embedded --in this case the CIC. The second step was to identify the four CIC subsystems: surface, anti-air, and anti-submarine operations, and preparation for assuming the watch.[6] The third step was to identify functions. An example of this level of statement is "detection, identification, tracking, and reporting of surface contacts." Table 1 gives the four subsystems and major functions. The subsystems and functions to be listed are only those within the boundary specified by the course mission.

The fourth step was to break each major function into task areas and then into smaller and smaller tasks until a level of detail was reached that made it possible for each task to serve as the behavioral element of an end-of-course objective for the duty assignment. This criterion made it possible for these objectives to be used as lesson plan objectives. This criterion means that each task should be so stated that it is specific enough to be taught and evaluated as a unit, i.e., the behavior element should not include elements which require different exercises or conditions, different tests or which must be taught in different parts of the course.

The task inventory for the CICWO assignment was revised in terms of the above criterion and is given in Appendix A. Note the contrast between the specificity of the tasks in Appendix A (several of which are given below) and the meaningless example given on page vi, e.g., "have a thorough working knowledge of the system." Note also that the

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[5] The terms used to identify the levels from system to operational step are arbitrary, at least for training purposes.

[6] "Preparation for assuming the watch" is not a subsystem in the same sense as others mentioned. As the course design of the CICWO course proceeded, it was found useful to treat it as though it were. I markedly facilitated instructional planning. This discovery is an illustration of (1) the manner in which course design steps interact with one another and (2) the arbitrary nature of the labeling of the various levels of systems analysis. One uses terms like area, function operational step, or whatever terms seem best adapted to the material with which one is dealing.

TABLE 1

Major Functions for Each Subsystem Involved in the CICWO Position

1.0 PREPARATION FOR ASSUMING THE WATCH

    1.1 Checking of Stored Data

    1.2 Determination of System Status

    1.3 Watch Planning

2.0 SURFACE OPERATIONS

    2.1 Detection, Identification, Tracking, Evaluating, and Reporting of Surface Contacts

    2.2 Maneuvering to and Maintaining Station in Formations and Screens

    2.3 Radar Piloting and Navigation

    2.4 Man Overboard

3.0 ANTI-AIR OPERATIONS

    3.1 Detection, Identification, Tracking, Evaluating, and Reporting of Air Contacts

4.0 ANTI-SUBMARINE OPERATIONS

    4.1 Detection, Identification, Tracking, Evaluating, and Reporting of Submarine Contacts specificity of the tasks meets the criterion that each can serve as the behavioral element of an objective--e.g.:

1.1.2 Data Extraction

Determines information, events, and procedures applicable to his watch by reviewing:[7]

1.1.2a pertinent operations orders

1.1.2b CO's night orders

1.1.2c pass-down-the-line (PDL) log

1.1.2d pertinent messages

1.1.3 Data Interpretation and Amplification

Amplifies and interprets data derived from operation orders, Night Order, PDL log, and messages, by referring to:

1.1.3a doctrinal publications

1.1.3b fleet and ship standing operation procedures (SOP)

1.1.3c intelligence materials

2.1.1a Monitors surface search radar operator in search for and detection of surface contacts and processing, display, and reporting of contact data.

2.1.1b Determines closest point of approach of surface contacts from radar plotting head.

2.1.4a Monitors sound powered telephone talkers in receiving and processing incoming surface contact data.

2.1.5c Determines accurately the CPA of a surface contact on maneuvering board, performing all operations required for solution.

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[7] Headings such as this apply to each of the tasks below them. Use of this kind of stem is adopted for economy in writing.

2.1.10a	Selects significant surface content data for dissemination to various command levels.
2.1.10c	Selects the appropriate whistle signals and/or maneuvers required of own ship for a given Rules of the Road situation.
2.2.4b	Estimates rapidly the course and speed for own ship to station, plotting or visualizing desired relative motion on maneuvering board and correlating with Guide's true motion.
2.3.1a	Monitors surface search radar operator in obtaining bearings and ranges to navigational points during radar piloting, and in processing, display, and reporting of radar piloting data.
2.4.1a	Interacts with CIC Watch Coordinator in maintaining CIC in alert posture for man overboard.
3.1.12a	Translates significant, evaluated data into appropriate format (coded or plain language) for dissemination.
4.1.7c	Monitors radiotelephone operators in accurately transmitting significant, evaluated submarine contact data to other units and commands.

The words used to describe the levels of classification (i.e., subsystem, function, etc.) in this approach are, as noted, arbitrary. In applying the concept of the systems approach to the course mission "to provide as much practice as is possible in a five-day course in applying current AAW tactics for senior officers who will occupy the positions in a task force of the specified list of officers," the task force can be considered the largest unit, i.e., the system, and the officer positions or duty assignments as the next level of categorization, i.e., the subsystems. The duties can be analyzed into as many levels as needed until the level is reached where each task can become the behavior element of an end-of-course objective for the duty assignment. End-of-course objectives can of course be stated in the terms of combinations of these "operational step" units. This will be generally the case when training the experienced CICWO for general improvement in efficiency or for particular combinations of deficiencies observed during fleet operations. For example, an objective might be written for the entire area of data extraction, inventory task area number 1.1.2, "Extract from all sources data applicable to your watch," or in terms of a subsystem function 2.1., "Detect, identify, track, evaluate, and report surface contacts during a 30-minute mock-up simulation of a condition III problem." The Task Inventory should contain the basic tasks for the duty assignment, whatever the combination that might be made for training more experienced personnel. These basic tasks will be found useful in lesson planning, regardless of the experience level which is being trained.

Importance of Task Statement Criterion

The utility of the criterion that each task be so stated that it can serve as the behavioral element of end-of-course objective can scarcely be overemphasized. Meeting this criterion enormously simplifies the course design process. It does this by making it possible to deal with the problem of deriving the subordinate knowledges and skills needed to perform the task as an integrated part of lesson planning (Step 7) and in an informal manner. This almost eliminates the need for making any special lists of subordinate knowledges and skills to be used as behavioral elements of objectives (These knowledges and skills of course are contained in the lesson plan). This in turn makes possible for end-of-course objectives to serve without modification as lesson plan objectives. The specificity of statement is such that standards are for the most part directly implied in go-no-go terms, i.e., the student can either do the task or he cannot.

It is the specificity of the tasks that meet the criterion that brings about the dealing with subordinate knowledges and skills as part of lesson planning. Consider Task 2.1.10c, "Selects the appropriate whistle signals and/or maneuvers required of own ship for a given Rules of the Road situation." It is hard to imagine two job-experienced CICWO instructors disagreeing markedly on what knowledges and skills are needed to perform this task. They would take them into account in outlining their lesson plans. For this reason, in the revised procedure the derivation of knowledges and skills is treated far less formally than it was in the preliminary edition of the Manual.

The instructor has a check on whether he has in fact taken into account all the necessary knowledges and skills. Step 9 includes testing student attainment of the objectives; Step 10 is the feedback step. If students in any number do not attain the objectives, one of the points for the instructor to check is whether the needed knowledges and skills have been included in the instruction.

Other Ways of Developing a Task Inventory

As already noted, the problem in developing a task inventory concerns not the need for a task inventory, but how it is developed, by whom, and to what level of detail. The development of a task inventory however is not an easy task: hence, most instructors are tempted to ignore it. It is safe to say that ignoring this step in course design detracts markedly from the effectiveness of a course. Conversely, the improvement in instruction that could be expected if design of every Navy course accomplished this step is literally uncalculable.

While it is believed that a systems analysis is the safest way to develop a task inventory, there may be other ways to do so. One way is to observe a representative sample of job incumbents over a long enough period of time to accumulate a list of all the tasks performed. Another is to have a group of job incumbents keep a diary. Another is to review official publications; often these have recorded a great number of the tasks. Another, and this is the absolute minimum that can be expected from any instructor who is serious about his instructional responsibility, is what might be called the "accretion" method. An instructor can make as complete a list of tasks as he can think of and have it reviewed over time by job experts and other instructors until no one can add to it.

Any of the methods except possibly systems analysis leaves open the problem of how to organize the tasks for instructional purposes. How the systems approach appears to result in an instructional organization will be considered under Step 4. Nor do other methods insure that the tasks have been stated in the best possible manner for instructional purposes. For example, task requirements for the CICWO include the solution of certain maneuvering problems. Stated in this form, the requirements might be met by teaching maneuvering problems entirely in terms of the maneuvering board. However a task inventory developed on the basis of the systems analysis approach, reminds the instructor that aboard ship a CPA is often derived on a radar scope; course and speed are often determined on the DRT. Tasks stated in such terms lead to objectives in which they are the behavioral elements.

In the discussion of the means of obtaining a list of tasks, heavy reliance has been placed on our experience in designing an operational course. Technical courses, particularly those the mission of which is to prepare students for a core of tasks common to a variety of positions, may require some adaptation of this step. A straightforward systems approach would require that each system the student would be a part of in his immediate billet, be identified and analyzed to develop the task inventory. One can combine several approaches to make sure coverage is complete and accurate. This was done in the design of the NTRL experimental course for electronic technicians. The systems approach was applied by identifying the elctronic systems and equipments on FRAM II DDs and reviewing the functions of ETs in relation to these systems (radar, communications, etc.). This approach was supplemented by reviewing (1) the task information previously obtained from a survey of 382 ETs which included a one-week job-sample; (2) the Qualifications for Advancement in Rating; (3) the Planned Maintenance Systems (PMS) tasks for ETs; and (4) technical manuals for NAVSHIPSYSCOM electronic equipments on DDs. The results of this combination of approaches were incorporated in a set of general objectives, the specifics of which come close to being a list of tasks, rather than in a Task Inventory. If the equipment cannot be specified for an initial course, a prototype system can be used as the basis for the systems analysis. No matter what basis is used for the development of the Task Inventory, the area of coverage must be limited by the constraints concerning how and where the training is to be used immediately following graduation from the course, i.e., by the course mission. Use of the nature of the supporting subject matter as the sole guide to determine what to teach leads to educational not training courses.

The importance of a complete, accurate, unambiguous, job-oriented list of tasks stems from the manner in which it controls course content. Such tasks exert this control by serving as the behavior element in end-of-course objectives, which in turn control the content of each lesson plan, and as a basis for deriving the subordinate knowledges and skills. An advantage of a correct application of the systems analysis approach is that it guarantees that the coarse designer begins with a job orientation--not an educational one. There is less chance of irrelevant material creeping into the course. Use of relatively unsystematic methods of obtaining this list, places a greater burden on course designers or improvers to insure that the manner in which they start the task inventory guarantees completeness of coverage, the elimination of the irrelevant, and the statement of tasks in job-performance oriented terms.

Types of Personnel to Construct Task Inventory

Four kinds of knowledges and/or skills are needed to design a job-related course: (1) knowledge about the job (the subject matter expert), (2) skill in system, function, job, and task analysis, (3) skill in applying knowledge about training, and (4) skill in applying what is known about how adults learn. The first two are needed for the development of the task inventory, the last two for the remainder of the steps in the course design process. These four knowledges and/or skills are rarely embodied in the same person, a fact which points to the desirability of a team approach to course design. While the team approach was employed in the design of the CICWO course used as illustration in this Manual, technical assistance concerning skill in systems analysis may not be available in the instructor's immediate locale. It may turn out that the main technical assistance needed is in developing with the instructor an appropriate organization to serve as the basis for the systems analysis. From this point on the instructor may be able to carry on the process by himself. It is strongly urged that instructors call for technical assistance to accomplish this step from some such organization as the Navy Training Research Laboratory. One of Navy's training management problems is to identify what help instructors are going to need and developing a means of providing this help to them.

STEP 3. ESTABLISH GROSS JOB ENTRY STANDARDS

The Task Inventory identifies the tasks towards which the training is to be directed. These tasks however are so stated that they specify what the experienced job incumbent must do successfully. Typically a course does not train all tasks to the proficiency level that is required by the experienced and successful incumbent. The decision that has to be reached for each task therefore is what level of proficiency the course should be designed to attain. How this question is answered will have marked effects not only on time requirements for the course but on how objectives are stated and evaluated and on how the material is taught. Teaching monitoring of watch personnel to the level of experienced CICWO performance requires much more realistic practice than teaching only what procedures are required to perform this monitoring task as a basis for rapid shipboard learning.

How should one go about setting such gross standards for tasks toward which the training is directed? The general procedure is to get information about the standards from job-knowledgable people. When there is much more than can be taught in any realistic course time allotment, it is of particular importance to obtain information about minimum job-entry standards in order to direct instruction to those considered the most essential. The question to ask these job-knowledgable people is how much does the course graduate need to know and/or how much skill must he have in performing a task when he enters his first assignment to prepare for qualification as a CICWO. Use of the scale below is one way to obtain answers from such people:

(IN USING THE RATING SCALE BELOW, PLEASE REMEMBER THAT IT APPLIES TO THE NEWLY TRAINED OFFICER AT TIME OF INITIAL JOB ENTRY)

CICWO TASK INVENTORY RATING SCALE

1. Course graduate should be able to perform this task with the same speed and accuracy as an experienced CICWO.

2. Course graduate should be able to perform this task with almost the same speed and accuracy as an experienced CICWO.

3. Course graduate should be able to perform this task with acceptable accuracy, but less than acceptable speed.

4. Course graduate should be able to perform this task, but with less than acceptable speed and accuracy.

5. Course graduate should know the procedures required to perform this task, but need not be able to perform it.

6. Course graduate should know that the task must be accomplished by an experienced CICWO, but need not know the procedures nor be able to perform it.

7. Course graduate should be expected to have neither knowledge of, nor skill in performing, this task.

A way of speeding the collection of data is to make a formal survey using the above rating scale to collect the information from a representative sample of job incumbents, their superiors, and their CIC watch coordinators.

To summarize the course design steps thus far: Step 1 stated the mission which established the boundaries of the course; Step 2 identified the tasks in terms that can be used as behavioral elements in the objectives; and Step 3 established gross job entry standards. All these steps have a great deal to do with controlling the course content and even at this early point in the course design process, have begun to throw light on the kind of teaching methods that are most appropriate.

STEP 4. GROUP TASKS FOR INSTRUCTIONAL PLANNING

This step has three substeps around which the discussion will be organized. The substeps are:

a. Group inventory tasks into major instructional units.

b. Identify basic skills or tool subjects involved and integrate their teaching with appropriate major instructional units.

c. Within instructional units, group tasks into lesson plan units suitable for course organization and scheduling.

Step 4 begins instructional planning. Note that it begins before the statements of objectives are complete. The first substep is to group the inventory tasks under major instructional units. It turned out for the CIC Watch Officer course that these instructional units could come directly from the major headings in the task inventory, usually function or task area. If the systems analysis approach uniformly results in functions and areas that can be used as the headings for instructional units, this will be a powerful argument for the use of this approach in developing the task inventory. The major instructional units for the CICWO course are given in Table 2.

With the tasks grouped under instructional units, they should be scanned in order to determine basic knowledges and skills needed. In other words, the tool subjects should be identified: e.g., radar, sound powered telephone, etc. Each tool subject should be briefly identified under each instructional unit where it will be needed. Note that tool subjects are merely identified at this point. No effort need be made to determine which aspects of, or how much of, each tool subject need be taught. That comes later under lesson planning. Note, too, that tool subjects should not necessarily be taught as units, but their teaching integrated with that concerning the tasks where they will be needed. Table 2 also gives the tool subjects identified for the CICWO course and shows how their instruction will be distributed across the various instructional units.

TABLE 2

INSTRUCTIONAL UNITS AND BASIC TOOL SUBJECTS

INSTRUCTIONAL UNITS

Detection, Identification, Tracking, Evaluating, and Reporting of Surface Contacts
Tool Subjects: 1, 2, 3, 4, 5, 6

Maneuvering to and Maintaining Station in Formations and Screens
Tool Subjects: 1, 2, 3, 5, 6

Radar Piloting and Navigation
Tool Subjects: 1, 3, 5

Man Overboard
Tool Subjects: 3, 5, 6

Detection, Identification, Tracking, Evaluating, and Reporting of Air Contacts
Tool Subjects: 1, 4, 5, 6

Detection, Identification, Tracking, Evaluating, and Reporting of Submarine Contacts
Tool Subjects: 1, 3, 4, 5, 6

Preparation for Assuming the Watch
Tool Subjects: 1, 3, 4, 5, 6

BASIC TOOL SUBJECTS

1. Radar
2. Maneuvering Board (MB)
3. Dead Reckoning Tracer (DRT)
4. Intercept Search
5. Internal Communications
6. Radiotelephone

Having identified instructional units and tool subjects, it remains to develop tentative lesson plan headings within each instructional unit and to place each task under the appropriate lesson plan heading. Lesson plan headings for the first instructional unit for the CICWO course are given in Table 3. Note that of the 15 lesson plan headings, 13 concern on-the-job tasks and two, tool subjects. Tool subjects should be used as lesson plan headings only when they are complex, such as the fundamentals of radar and principles and procedures of intercept search. For less complex tool subjects or aspects of tool subjects, the lesson plan headings should be task oriented and the basic information needed be incorporated in the lesson plan outline (Step 7).

Once the tentative lesson plan headings are decided upon, the instructor should group the inventory tasks under them. The purpose is to bring together a small group of tasks suitable for lesson planning. From this point on until their integration, the instructor can work with one lesson plan unit at a time.

STEP 5. DETERMINE TRAINING EXERCISES FOR EACH TASK

Working with the inventory tasks under a single lesson plan heading, the instructor should now devote intensive thought to the method of instruction which is most appropriate to each task with its gross job-entry standards. This involves primarily the development of exercises for giving practice in performing the tasks. The instructor's goal should be to so design the exercises that the responses evoked from the student are essentially similar to those he will make on the job. This does not mean that the task must be practiced under the exact conditions found on the job. In fact, a major reason for having shore-based training is to make the instruction more efficient than it can be at sea. Shore-based training does this by providing more practice on tasks in much shorter periods of time than will occur under operational conditions. To develop completely realistic exercises, in the sense of duplicating all operational conditions, is therefore completely inconsistent with the reason for having a shore-based course.

Training a CICWO in monitoring, by utilizing fully manned mock-ups, and using exercises to duplicate a normal steaming condition would be highly inefficient. With experienced personnel manning the mock-up stations, errors would occur so infrequently that the training value would be nil. Even instructing operators to make mistakes would not be really efficient, because it requires so many personnel to fully man the mock-up stations. It is more efficient to devise an exercise that can be used under classroom conditions and with no involvement of other personnel. In the instance of training for monitoring, an exercise can be designed, proper displays of the surface picture provided, and the operators communications taped with the kind of errors of concern included. All students can then practice monitoring simultaneously. Should a highly sophisticated computer-based mock-up be available, the same principle applies. Exercises should still be devised to include the errors the instructor wishes to emphasize. It will often be found

TABLE 3

LESSON PLAN HEADINGS FOR ONE INSTRUCTIONAL UNIT

INSTRUCTIONAL UNIT: Detection, Identification, Tracking, Evaluation, and Reporting of Surface Contacts

LESSON PLAN HEADINGS

1. RADAR 1: Introduction to Radar: Principles and Procedures
2. RADAR 2: Surface Search Radar in Detection and Tracking of Surface Contacts
3. MB 1: Closest Point of Approach of Surface Contacts
4. MB 2: Course and Speed of Surface Contacts
5. MB 3: Avoiding Course in a Surface Contact Situation
6. DRT: Course and Speed of Surface Contacts
7. ECM 1: Introduction to Intercept Search: Principles and Procedures
8. ECM 2: Intercept Search Signal Evaluation
9. COMMUNICATIONS 1: Internal Reporting of Surface Contacts
10. COMMUNICATIONS 2: Radiotelephone procedures in Surface Contact Reporting
11. Radar and Intercept Search Guards, EMCON, and Time-Sharing Plans
12. Rules of the Road in a Surface Contact Tracking Situation
13. Surface Summary Plot, Surface Status Board, and Surface Contact Evaluation
14. Monitoring CIC Watch Personnel in a Surface Contact Situation
15. MOCK-UP: Surface Contact Detection, Tracking, Identification, Evaluating, and Reporting

desirable to run the exercise in faster (or shorter) time than occurs in real life to maximize the training benefit.

In the above illustration, the similarity of response of the student in the classroom and on the job seems sufficiently close to permit the inference that what the student learns in class he will be able to use on shipboard. When there is doubt on this point, special studies should be conducted to insure that what is learned in school promotes performance on the job.

Trying to create completely realistic training conditions can lead to much unnecessary expense. An illustration of the money that can be saved by not insisting on real equipment or expensive simulation thereof is provided in a study by Cox et al. (1965) cited in Crawford (1966). He found that "a 92-step procedure at a missile-launcher control panel can be learned as well with a small-sized drawing as with a fully operational simulator" (p. 792). Crawford concludes from this and other studies that simulation for the purpose of learning *procedures* does not need to be of a high fidelity. Where such evidence is available the inventory task needs no restatement to show what is really being trained.

There are however tasks that cannot be trained for, because of lack of training capability and where no evidence is available to suggest that training under conditions that are not reasonably similar to on-the-job conditions will transfer to the job situation. In such instances the task should be modified to one that can be taught in the training situation. This will promote communication between the lesson planner and the students, training management, and other instructors concerning what is being taught in the course. To illustrate, Task 1.2.2*a*, "Determines if external surface search radar controls are properly set for assigned function of equipment (e.g., long range surface guard, radar piloting) and for satisfactory scope presentation," can be taught only if a live or computer-driven radar, capable of producing realistic scope pictures, including clutter, weather effects, etc., is available. If such conditions do not exist, the task should be rewritten to show what is being taught, in some such manner as this: "Determines from pictures of surface search radar controls whether they are set properly for assigned function and discriminates pictures of satisfactory radar repeater presentations from pictures of unsatisfactory presentations."

In a similar manner Task 1.2.2*b*, "Adjusts, or directs adjustment of, [surface search radar] equipment as necessary," needs to be changed to something like, "Locates on dead radar repeater specified controls and describes their function and the effects of their misadjustment on the radar presentation."

The above discussion has concerned those tasks that are to be taught at the *performance* level, i.e., those rated 4 or better on the scale on page 20. Those rated 6 or 7 can be ignored so far as stating objectives are concerned, although plans for disseminating the information needed at the 6 level will appear somewhere in a lesson plan, either in terms of assigned reading, lecture, or possibly programmed instructional material. It is those rated 5, i.e., those to be taught in terms of knowledge about rather than in terms of performing that are referred to here. The statement of tasks of this kind should be modified in terms of what the student is expected to do with the information. Suppose Task 1.3.1b, "Determines procedures for implementing guards and EMCON and time-sharing plans, briefing watch personnel as required," is rated to be taught in terms of knowledge about. One way of modifying this task is "specifies equipment and manning assignments, given the situation, and lists the major reasons for the decisions." This modification puts the task in terms of the way it is to be practiced during the training situation, and it communicates to the student what he will be required to learn as well as to others concerned with what the course really teaches.

Exercises Concerning More Than One Task, i.e., Higher Order Tasks

Thus far, tasks in the inventory have been treated as though they were to be trained for separately, and their achievement tested separately. On the job or duty assignment however many of the tasks are performed in rapid succession, i.e., integrated or combined in some manner. For example, there are 47 monitoring tasks in the inventory. It may not be likely, but it is possible that air, surface, and subsurface targets may all be present during a normal steaming situation and the CICWO would have to monitor many operators, displays, and so forth, practically simultaneously. It has to be decided at this point which, if any, of the tasks are to be practiced together, because it will require additional exercises; e.g., there will need to be separate exercises for Task 1.1.2a (Determines information, events, and procedures applicable to his watch by reviewing pertinent operation orders) and for Task 1.1.3c (Amplifies and interprets data derived from operation orders, Night Orders, PDL log, and messages, by referring to intelligence materials) and for both tasks combined. The more tasks needed to be practiced as integrated tasks, the longer the course will need to be. Special investigation may be needed to determine whether it is more efficient to let all the integration of tasks develop through shipboard practice and training, or whether an attempt should be made to train some integrated tasks in the shore-based course.

There is a very good reason for training and testing task performance or the modified task performance separately and then testing the performance in as realistic a setting (for the CICWO, this is in mock-up) as the training facility permits, using well-thought-out preprogrammed problems. The problems can be so programmed that the task performance can be evaluated as it occurs separately and when it must occur when other tasks are to be performed nearly simultaneously with it. Following this procedure the instructor will discover (1) how well the student has learned to perform the task when it is only this single task he has to think about, (2) how well he can perform the task amid the distractions that can occur in a more realistic setting when the particular task is the only one programmed to occur at a particular time, and (3) how well the task can be performed amid the greater distractions occurring when other tasks must be performed in close conjunction with the one of interest. Following such a procedure will provide the instructor information concerning the amount of practice that must be provided the student in situation (1) before he can be expected to perform to standard in a more realistic setting. It will also provide the instructor a means of evaluating whether the modifications he had to make in these tasks for training purposes make a significant difference in the training for the on-the-job task as stated in the Inventory. The instructor may also get insight on how to program his problems in training for the single task to hold to a minimum any loss in performance that comes about in the more realistic situation, as well as into the problem of the most efficient combination of single tasks and combined task training.

Mock-ups are frequently used for so-called familiarization purposes. With a well-programmed problem they can be used for the above purposes while accomplishing the familiarization purpose. "Familiarization" does not warrant statement as a task, or objective, however. In performing any task the student clearly needs to know the context in which he is going to perform it on the job. Mock-up for familiarization is better relegated to the lesson plan as one of the means for training to accomplish the more specific tasks.

STEP 6. STATE TENTATIVE END-OF-COURSE OBJECTIVES

The statement of unambiguous and complete objectives is usually considered the key to good training course design. This Manual demonstrates this to be an over-simplification, but they are important if they do concern the right tasks. Perfect objectives can be written for irrelevant as well as relevant tasks. To be sure the objectives do concern the right tasks has been one of the primary purposes of the steps in our course design procedure to this point.

On page 2 an objective was defined as a statement of the specific behavior the student is expected to demonstrate at the end of the course. It was pointed out that it contains three elements, the behavior, the conditions under which it is to be performed and the standards of performance expected. The behavior element comes from the Task Inventory (Step 2) or from Step 5 when a task is modified to be consistent with training capability or with the gross standards established in Step 3. If the behavior element is stated correctly, standards are directly implied in go-no-go or pass-fail terms. This is a marked shift in point of view from the preliminary edition of the Manual. This point of view divides the problem of standards into two parts--the question of the standard itself and the question of evaluating whether the standard is met and clarifies the role of each part, as can be noted from later discussion.

Purpose of Objectives

In addition to their purpose of informing course designers in controlling course content and in guiding methods of instruction, end-of-course objectives have four communication purposes. The first is to inform the student what he is expected to learn during the course. Students should be given a copy of the objectives at the outset of a course. The second is to communicate in brief fashion with those who send students to the course. Shipboard department heads, for example, should know what the student has learned for purposes of planning efficient shipboard training. The third is to communicate with training management personnel, such as those responsible for authorizing the establishment of courses and reviewing them for consistency with the course mission as well as those responsible for providing instructional supervision.

The fourth purpose is to communicate the targets of the course from instructor to succeeding instructor. Even if objectives are well implied by a lesson plan, unless they are identified explicitly, changes which bring in unnecessary content are inadvertently made. With the objective explicitly stated, such changes are not likely to occur.

Stating the Objective

To fulfill these communication purposes objectives must be written to convey the specific behavior that is taught and imply the standard and the conditions, or, when these are not clearly implied, add a direct statement concerning them. To convey what behavior is actually taught in the course it is frequently necessary to indicate the conditions of the instruction and/or the manner in which task performance is evaluated, i.e., tested. The statements of the behavior to be taught were developed in Steps 2 and 5. When nothing is said about standards, it is directly implied that the course graduate can do the task as stated. The student can recognize an unsatisfactory surface search radar presentation taught in terms of the assigned function and in terms of misadjusted controls; or he can locate the specified information in an operation order. He can compute a CPA on a radar plotting head. He can solder a wire to a terminal lug. He can type a letter following prescribed format. Standards implied here, it will be recognized, are essentially go-no-go. The instructor must however develop the means of evaluating (testing) whether the course graduate can, in fact, perform each task. On this subject, more in a moment.

The standards implied concern the accuracy and time customarily accepted on shipboard as adequate at a particular stage of Navy personnel experience. There is one circumstance however where the addition of a quantitative time standard to the objective is clearly desirable. Tasks which have definite on-the-job time standards provide the illustration. Checking out a missile system for operational readiness has a number of steps. Suppose for one such step, shipboard standards require that this be accomplished in less than five minutes. Suppose however that in the time allotted to the instruction for this step, it is found from experience with a number of classes that most students require 10 minutes to perform the check. In such instances the time standard, 10 minutes, should be added to the objective. This tells responsible management that either provision must be made to bring the graduate up to the standard of five minutes after he arrives on the job, or the course lengthened to enable the standard to be met, or a trade off be made by reducing time allotments for other objectives and increasing it for this particular check.

Examples of Well Stated End-of-Course Objectives[8]

1. Decodes and interprets from ATP-1(A), Vol. II, written messages representative of maneuvering to and maintaining station in formations and screens (Inventory Task 2.2.2c).

2. Detects errors in detection, processing, display, and reporting of contact data during a programmed exercise consisting of representative samples of audio-taped radar operator reports and corresponding pictorial radar presentations (Inventory Task 2.1.1a: "Monitors surface search radar operator in search for and detection of surface contacts, and processing, display, and reporting of contact data"). Since the behavior to be taught, with taped reports and pictures of radar scopes is considerably different from the task on-the-job, the task itself is given for reference.

3. Determine whether external DRT controls are set properly, given general situations, including location of ship, type of operation, and course and speed (Inventory Task 1.2.2n).

4. Evaluates electronic signals rapidly as to type (search, fire control, etc.) and function (long-range, tracking mode, etc.), given sets of signal characteristics, at least one of which in each set clearly identifies the emitter on the basis of general type and function guidelines.

5. Estimates rapidly the course and speed of surface contacts given a series of written and pictorial problems indicating own ship's course and speed and relative motion of contact (Inventory Task 2.1.1c: "Estimates course and speed of surface contacts from radar plotting head, plotting or visualizing relative motion of contact and correlating with own ship's true motion"). Since the behavior to be taught changes because of lack of training capability, the task itself is given.

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[8] To enhance the communication value of an objective, it is good practice to underline the significant behavior elements.

Developing Tests

As noted, the instructor must determine whether the student can perform the task as stated in the objective. And he must do this in the same manner for all students over a succession of courses. The reason for this emphasis on systematic evaluation is simply because this is the basis for the feedback loop of Step 10. And this feedback loop is the critical step in continued course improvement.

If one has tests, why not use test scores for stating the standards? It is because it confuses the problem of standards with the problem of measurement. What the instructor is concerned with is the student's ability to perform a task. There will be error however in the way he measures this, e.g., a student detects 90 of 100 errors in a monitoring test. To discover whether detection of 80, 90, or 40 errors in a possible 100 on a test is sufficient to be able to do the task on the job requires the kind of study that cannot be expected to be done for the majority of training courses. In most cases therefore the problem of standards comes down to the instructor's judgment on what he will accept as evidence for meeting the standard directly implied by the way the task is stated. What saves the situation is the specificity with which the tasks are stated. There is a reasonable possibility that the instructor can make this judgment in terms of his job experience for very specific tasks. Further, if tests were used as the basis for the standards, standards would change every time the test changed. Objectives could then require restatement so frequently as to hinder their communication purposes.

Tests however must be developed to evaluate student attainment of the ability to perform the task. By "tests," all that is meant is a systematic and consistent way for the instructor to find out whether his students can do the task stated in the objective. It can be an oral test, i.e., be based on asking the same questions of each student. It can be a written test. It can be a performance test, performed under the instructor's observation, the instructor being armed with a checklist showing what he is going to observe, i.e., a series of problems such as adjusting a radar to achieve a standard satisfactory presentation or computing a series of CPAs on a radar plotting head; or a performance test when the student indicates his answers in writing, i.e., detecting errors in a taped recording of CIC operator reports.

Even with the specificity of the tasks however the instructor will find that the first time he gives a test that some questions are not asked so students respond as expected, or an exercise, such as the tape of radar operator reports, described earlier, can present unexpected problems. Before a test can be used therefore some trial and error is needed to make sure it is well constructed. Once an adequate test is achieved, it should not be altered until it has been used for a series of classes. This is to make it possible for the instructor to compare the effects of different instructional methods, different time allotments, different course organizations, etc., on the student attainment of the objectives.

This does not mean that tests should never be altered. It means, rather, that the alteration should not be continuous, small changes, but should be coordinated with the instructor's purposes in comparing different time allotments, methods, or course organizations to determine which is the most efficient in getting the students to achieve the objectives. All needed changes should then be made and the cycle repeated. The instructor should never forget that his major purpose in evaluating student performance is to improve the course, not to evaluate the student.

Standards, then, are directly implicit in the statement of the task in go-no-go terms. Tests help the instructor judge whether the standard has been met and provide him with the information needed to improve his course.

In constructing that part of the test for the attainment of Task 1.2.2a concerned with students' ability to detect an unsatisfacotry scope presentation, the instructor can push the task analysis a bit further to determine what unsatisfactory presentations should be intermingled with satisfactory presentations for the student to discriminate. It is the adjustment of the controls that is responsible for the unsatisfactory presentation. Therefore the test can be built in terms of a series of misadjusted controls, like the following:

a. The focus control misadjusted by 90° or more from an optimum setting (as selected by instructors).

b. The intensity control misadjusted by 90° or more from an optimum setting (as selected by instructors).

c. The video gain control misadjusted by 180° or more from an optimum setting (as selected by instructors).

d. The range scale set at 50 miles when the function of the repeater is normal surface search; or with the range scale set at five miles when the function of the repeater is long range surface search.

e. The STC control ON in sea-state conditions of zero to one; or with the STC control OFF in sea-state conditions of four to five.

f. The radar repeater in relative bearing when true bearing is required; or vice versa.

g. The function selector set for an inappropriate input for the use specified for the repeater, e.g., air-search radar presentation on surface search repeater.

A little trial and error with such misadjustments, and the instructor will have his test.

Since the tasks are so specific, tests can normally be short--2-15 items will usually suffice. It is tests of such tasks as the various monitoring functions which must be longer, because of the wide variety of errors which the student must learn to recognize. From the student's point of view the test will usually appear as a continuation of the kind of exercise he has been practicing. From the instructor's point of view the test is a good sampling of what has been taught rather than a continuation of the training.

STEP 7. DEVELOP AND ORGANIZE LESSON PLANS

At this point in the course design process, the instructor will have a set of end-of-course objectives grouped under lesson plan headings, which in turn are grouped under instructional units. The problem now is to plan and organize the instruction needed to achieve these end-of-course objectives, i.e., develop lesson plans.

A lesson plan contains: (1) end-of-course or subordinate objectives to be achieved in that unit, stated as shown under Step 6 (when the task in the end-of-course objective has been modified in terms of the considerations in Step 5, the inventory task should also be included); (2) an outline of instructional methods (demonstration, lecture, programmed instruction, supervised study, unsupervised study classroom exercises, or mock-ups, etc.) for attaining the objectives; (3) time estimates for each part of the lesson plan; (4) method for measuring attainment of the objectives, i.e., examination procedures; (5) reading assignments; and (6) materials, handouts, visual and study aids, and equipment needed. Lesson plans should outline content and instructional methods in such detail that two instructors would independently develop and present them in essentially the same way.

The format used and the manner of outlining the content and procedures of a lesson plan can be selected in terms of instructor preference. The objectives however should always be placed at the beginning. Each test or evaluation procedure used should either be briefly described or a copy of the test itself and the instructions for giving it attached to the lesson plan.

Lesson plans can be developed by means of the following substeps:

a. Derive from each end-of-course objective the subordinate tasks needed to achieve it.

b. Adjust and refine statement of objectives.

c. Adjust assignment of objectives to lesson plans.

d. Organize and sequence the instruction, lesson plan by lesson plan.

e. Construct tests needed for pacing lesson plan instruction for particular subordinate objectives.

Derive from Each End-of-Course Objective the Subordinate Tasks Needed to Achieve It

This is not intended to be a formal substep in the sense of requiring a listing of the subordinate tasks prior to incorporating the manner of their instruction into the lesson plan. Sometimes in considering an unusually complex end-of-course task, the instructor may find a listing helpful, but it is believed that most of this derivation can be managed mentally by the instructor and incorporated directly into his lesson plan outline. For example, no experienced CIC Watch Officer instructor will have any doubt about what needs to be taught to achieve the behavior, "Determines information, events, and procedures applicable to his watch by reviewing pertinent operation orders," or the behavior, "Selects the appropriate whistle signals and/or maneuvers required of own ship for a given Rules of the Road situation," or the behavior, "Evaluates intercepted signals rapidly as to type and function of emitter using general guidelines based on one or more major electronic characteristic." It is the application of the criterion for statement of tasks in the inventory that each must be able to serve as the behavioral element of an end-of-course objective, that has markedly reduced the need for a formal listing of the subordinate tasks. Furthermore, the instructor has a check that is built into the course design procedure on whether he has omitted any knowledge or skill. This check will be discussed under Steps 9 and 10.

Note that the phrase _subordinate tasks_ has been used instead of the commonly used terms, _subordinate knowledges and skills_. This use of the word _task_ is selected to emphasize that for a training course whatever knowledges and skills are taught, are taught only to enable the student to perform some on-the-job task. Hence, so-called subordinate knowledges and skills are translated into as close an approximation of the operational task as is possible. The word knowledge seems to cause particular difficulties. Consider Task 1.2.2_a_, "Determine if external controls are properly set for assigned function of equipment (e.g., long range surface guard, radar piloting) and for satisfactory scope presentation." What "knowledges" are needed? How much does one have to know about the theory or fundamentals of radar in order to accomplish this task? Whatever the instructor decides, he should translate the knowledges into a task which requires the student to use the information provided. For example, knowledges like understanding the echo-ranging principle of radar, speed of radar energy and the units of its measurement, and time of the radar mile are all implied in the computation of maximum and minimum ranges of specific radars. The task then becomes "compute maximum and minimum ranges of radars, given such factors as pulse duration, pulse repetition frequency, and antenna height." This translation points directly to the kind of test the instructor should use to measure attainment of this subordinate task. Such tasks, in effect, become the behavioral elements of subordinate objectives. Whether these objectives should be listed at the beginning of the lesson plan, clearly labeled as subordinate, or incorporated in the lesson plan in relation to the test to be used by the instructor is a matter which concerns the needs of the chief instructor. When such subordinate objectives are taught in conjunction with the end-of-course tasks, it is probably sufficient for them to be incorporated into the lesson plan. When a lesson plan deals entirely with such knowledges, as may be the case with complex tool subjects such as fundamentals of radar, it is desirable to list them at the head of the lesson plan. Subordinate objectives should be provided the student but should not be required to communicate with training management personnel. Succeeding instructors can get them from the body of the lesson plan if they are not listed at the beginning.

It is emphasized that the knowledges required should be translated into the minimum number of tasks possible. Knowledges such as the distinction between Inland and International Rules of the Road, or the principle of operation of sound-powered telephone, requiring little instructional effort, even if they cannot be incorporated into a task, should be ignored so far as objectives are concerned.

How should the instructor decide how much of the "knowledge" concerning fundamentals of radar is to be used as the basis for formulating a task or series of tasks which will demonstrate use of the knowledge? The answer stems only from the end-of-course objective. No more should be taught than is needed to perform the task in the end-of-course objective. Sometimes this will be easy to determine, as in selecting the knowledges required to perform the task of computing minimum and maximun range cited on above. Often however the answer to this question of how much to include can come only from providing the student with differing amounts of information and determining whether the differing amounts make any practical differences, say, in his discriminating satisfactory from unsatisfactory presentations, or in recognizing when the external controls of a radar are properly set for the assigned function of the equipment. In general, the instructor should start by providing no information or the absolute minimum he believes will permit the student to perform the task. If the student can perform the task in the end-of-course objective with this amount of information, no more need be provided. If he cannot, the amount can be gradually increased until he can. The students' performance on such practice exercises as recognizing improper control settings and discriminating satisfactory from unsatisfactory presentations provides the test of whether sufficient information has been provided. By following this procedure the instructor can continue the instruction until the student is progressing satisfactorily on the practice exercises. Note that it is the practice exercises that can be used here. The final test of attainment of the end-of-course objective need not be. After experience with a class or two, the instructor will be able to pinpoint the amount of the knowledges needed and the best way of translating them into tasks.

The same considerations apply to subordinate skills as to knowledges, except that skills are not likely to need much modification or translation to become the task for the subordinate objective. The skill of pronouncing and properly using the many radiotelephone prowords, can be quite easily mastered in a classroom "talk-back" exercise before the task of using them in actual transmission is practiced.

It is at this point that the instructor may discover that some of his inventory tasks are not stated in the best manner for his instructional purposes or that some tasks have not been analyzed into sufficiently fine units. For example, Task 1.2.2a, "Determines if external controls are properly set for assigned function of equipment (e.g., long range surface guard, radar piloting) and for satisfactory scope presentation," contains two distinct subordinate tasks. They were both included in the same inventory task because it was believed that they could be taught and evaluated together, primarily because determination of whether external controls are set for the assigned function of the radar is a simple matter, and its teaching and evaluation could be readily combined with that for determining whether the scope presentation is satisfactory. If these beliefs turn out to be false, Task 1.2.2a should be divided into two parts in the inventory, and each would then become the behavioral element of an end-of-course objective.

There is a class of end-of-course tasks which may give particular trouble, not so much in identifying the subordinate tasks that are required, but in determining to what level of performance the subordinate tasks should be taught. This problem is involved in such tasks as monitoring and supervising. The particular issue of how much does a person need to know and/or how well does he need to perform a task in order to monitor it is especially troublesome. Just as with the question of knowledges, the problem cannot be resolved on the basis of logic alone. The same kind of trial and error experimentation described above will be required in relation to the achievement of the monitoring task so that each successive presentation of the course approaches more closely the target of teaching just the sufficient skill in performing to make possible effective monitoring of the task--but no more.

There are in addition tasks which cannot be simply analyzed into the subordinate tasks involved. This does not seem to be the case for any of the tasks in the CICWO Task Inventory, but an illustration is provided by an NTRL study (Ford & Meyer, 1966) in teaching flow charting for computer programming purposes. Experience with an NTDS computer programming course had repeatedly demonstrated that students with low mathematics aptitude did not learn the course content. After a series of studies, the tasks (in this case the mental processes) were identified and instruction programmed to develop and practice them. The low aptitude group did learn the material, but it took them more than 50 per cent longer than the high aptitude group. If an instructor discovers, despite considerable variation in methods of instruction, that students persistently fail to learn, about the only thing he can do is request the services of an institution such as NTRL to conduct the studies needed to identify the underlying mental tasks and devise ways of developing their use by the student.

It probably should be added that what and how much instruction to be devoted to any subordinate task will be influenced markedly by the nature of the student body. The differences in starting with a group of civilians and a group of Navy officers with some sea experience, in terms of achieving the objectives of a CICWO course are so obvious as not to deserve further comment.

Adjust and Refine Statement of Objectives

This substep is included as a reminder to inspect the original tentatively stated objectives (Step 6) to see if they can be improved. It also serves as a reminder to refine the statement of any task in the inventory that has not turned out to be suitable for instructional purposes.

Adjust Assignment of Objectives to Lesson Plans

This substep is concerned with adjusting the assignment of objectives to lesson plans, now that thought has been given to the subordinate tasks for which instruction will be needed. This step can lead to the formation of new lesson plans. Creation of these new lesson plans may come about because of the complexity of the tool subjects required. If a new lesson plan heading is created that concerns only subordinate objectives, it should be remembered that the subordinate objectives should be listed at the beginning of this lesson plan.

Organize and Sequence Instruction, Lesson Plan by Lesson Plan

With a set of objectives for a lesson plan (selected in terms of logic alone, with no reference to whether they will take 50 minutes or 250 minutes to do the instruction) and the subordinate tasks in mind, the instructor must discover the most logical manner in which to present his instruction, considering all the objectives that he has selected as sufficiently related to belong in the same lesson plan. In other words, he must examine the objectives and their subordinate tasks for similarities, differences, logical relationships, and logical time ordering. Achievement of some objectives must follow rather than precede achievement of other objectives. Some may be independent in that they may be covered at alternative points during the course. In any event, there is a logical order, or more than one logical order, for introducing a group of objectives to the student. The word "introducing" is used here because each objective will not necessarily be completely covered and achieved to the desired level of proficiency before the next one is introduced. Some objectives are complex enough to warrant spaced practice over time, with other material intervening between the practice sessions. From a content learning point of view however the objectives can be ordered for introduction to the students. Headings in the lesson plan should make evident this ordered listing. In this connection, such well-known principles as proceeding from the simple to the complex and from the known to the unknown come into play. In addition, learning principles must be considered.

Learning Principles

Once logical sequencing of material has been accomplished, it is learning principles that govern the organization of the lesson plan.

Principles pertinent to lesson plan content and organization are:

1. Instructional method should be consistent with the nature of the objectives.
2. Instruction should relate end-of-course and subordinate tasks taught to their use in the job situation.
3. Spaced practice and review promote learning.
4. Teaching highly similar tasks or materials in too close proximity (one too soon after the other) interferes with learning.
5. Variety in the day's instruction maintains motivation and helps overcome monotony and fatigue.
6. A variety of practice materials should be provided.
7. A context or framework should be taught for the student to use in organizing what he is to learn.
8. The student should be told what he is supposed to learn.

9. The student should be given knowledge of his progress and his errors. Use tests as learning experiences.

10. Instruction should be so arranged as to permit adaptation to individual differences in student aptitude and experience.

11. Instruction should be paced by the students' learning rates.

That instructional method should be consistent with the way the objectives are stated (principle 1) is self-evident. This means that the behavior in the objective makes a difference in the method of instruction. The behavior "energize a radar" must be taught using practice with live equipment, whereas the behavior "define a specified series of intercept search terms" can be taught by assigned general reading, assigned programmed instructional reading, or by lecture, plus a series of exercises or problems that involve the vocabulary. If conditions involve schematics or fabricated models instead of a live radar, methods of instruction may differ. Standards also make a difference. For an objective concerning what to do if a CICWO on watch hears "man overboard," the instructor will very likely insist on perfect performance as evidence the student can perform the task. In such cases he must arrange sufficient and spaced practice for overlearning to take place.

The importance of principle 2, relating tasks to their use in the job situation, cannot be overemphasized. The objective stresses what it is that should be practiced. Exercises should be so designed that the instructor can be sure that the subordinate as well as the end-of-course tasks involved are practiced by the student. In fact, ingenuity in developing exercises that are consistent with the objectives and evoke the behaviors as they are used on the job is a major factor in developing an effective training course. To illustrate with a now familiar example: the CICWO position involves monitoring flow of information and interpreting it in terms of previous information as well as information on a series of displays. To develop skill in this task, a series of messages can be developed and recorded on audio tape to be used in conjunction with appropriate displays, to give classroom practice to develop this skill in a very efficient manner.

The third principle can be illustrated by the scheduling of instruction in radar principles in the CICWO course redesign. Knowledge of these principles is required to perform tasks under both surface and air operations. Radar principles are first taught under "detection, identification, tracking, evaluating, and reporting of surface contacts." Here emphasis is placed on surface search radar, but the way the principles concern air search is also brought out. When the lesson plans concerning anti-air operations are reached, radar principles are reviewed with emphasis on air detection, identification, and tracking.

The fourth principle may be illustrated by the example of maneuvering problem solutions in the CICWO course. There are at least four major types of problems, each using the same general procedures, but differing in one or more specific operations. Teaching change of station, for example, in close proximity to the relative plot problem may cause confusion, and thus a longer time to learn.

The fifth principle is continuously violated in the use of lectures all day long. Used in such a manner, lectures do not promote learning. Lesson plans should be so integrated that there is variety in the students' day. There is nothing subtle about this principle. But it is too infrequently observed in the conduct of training courses.

The sixth principle--providing a wide variety of learning materials--is also well known. Instructor ingenuity in developing a variety of exercises to utilize the same skills and knowledges will be well rewarded. Implementation of principles 3, 4, 5, and 6 supplement one another to achieve good instructional conditions.

Instructors generally follow principle 7 to the extent of providing an overview of what is to be learned so that each student can relate the details that are to come to this larger context. They frequently provide block diagrams and information flow charts for this purpose. What many instructors neglect however is to (1) provide each successive breakdown of the subject its own schema, diagram, flow chart, or outline, and (2) to spend sufficient time on these schema to permit the students to really learn them. Such schemas cannot serve as a context to facilitate student acquisition and retention of details, unless they are LEARNED. Instructors should satisfy themselves that the students have learned these schemas before proceeding.

The student can manage his own learning to better advantage if he knows what he is supposed to learn (principle 8). The best way of letting him know is to tell him the specific end-of-course objectives. Frequently the only way a student finds out what he was really expected to learn is when he takes the examination. At this point, if he has not guessed correctly, it is too late. The importance of this principle cannot be overemphasized.

Closely related is principle 9--providing the student knowledge of his progress, and the more immediately the better. Providing the student immediate feedback of the results of examinations can be extremely helpful, especially if the results are discussed to provide a learning experience, rather than a grading one. Discussion of examination results in terms of attempting to discover why each student made the errors he did and what it is he must study or practice to do better can make an examination a true learning experience. To provide the student knowledge of his progress, the instructor obviously must have some way of finding out what it is. This is another reason for our stress on the importance of measuring progress and attainment of objectives for instructional purposes.

The tenth principle, making possible the adapting to individual differences, is generally ignored in planning a course. A schedule is set up and all students follow it as a group, despite the manifest differences among them in ability and previous experience. Two considerations are involved here: (1) the instructor must find out what students know when they enter the course; and (2) the course schedule must be set up to make it possible to treat students differently. To deal with the first condition, testing the students at the beginning of the course or at the beginning of each instructional unit with an alternate form of the test for the achievement of the end-of-course objectives for that unit or units can be conducted. Sometimes the end-of-course test itself can be used as the pretest. If a student, because of his experience and background, can pass an end-of-course test when he enters the course, his time will be better spent in some special assignment from which he will learn something new.

The second consideration, making it possible to treat students differently, also has a ready solution. By substituting supervised study or programmed instruction sessions for lectures, students can be removed from the class, singly or in small groups, for special or remedial instruction without interfering with the learning of the larger group.

A little reflection will show that this procedure will result in other gains in the effectiveness of the instruction. It can, for example, result in better and more efficient management of mock-ups by providing more instructor supervision for each mock-up. This follows from the fact that it takes but one instructor or assistant to preside over a supervised study or programmed instruction session. All the rest can be in the mock-up as simulators or as observers where no more students are involved than the instructors can manage. Another benefit of this effort to adapt to individual differences stems from the possibility of using the better students as assistants in the mock-ups or in assisting the less-well prepared trainees.

The eleventh principle, "instruction should be paced in terms of the students' learning rates," is clearly related to the principle of making possible adaptation of instruction to individual differences. But there is more to it than that. It concerns the time allotments not only to the instruction concerned with the end-of-course objectives, but also to the subordinate tasks. If a student cannot discriminate satisfactory from unsatisfactory surface search radar presentations, there is not much point in going on to provide him practice on the Task 2.1.1a, "monitors surface search radar operator in search for and detection of surface contacts and processing, display, and reporting of contact data." Or if he does not know the vocabulary of the intercept search function there is little use in practicing him in Task 2.1.2a, "monitors intercept search operator in search for and detection of electronic emissions and processing and reporting of intercept data."

This point is concerned with preventing waste of instructional time in teaching a task which the student is not prepared to learn. To pace instruction properly the instructor must discover if students are ready to move on. Many times classroom discussion or informal questioning of students is sufficient to discover this. Frequently however more formal tests will be needed because of the complexity of the material. There is so much intercept search vocabulary that informal questioning or class discussion could not cover it in a reasonable time. In Step 10 the feedback loop for the course as a whole is discussed in relation to the need for a systematic evaluation process for course improvement. Testing for attainment of subordinate tasks can be viewed as the basis for the feedback loop essential for pacing within lesson plan instruction.

Construct Tests Needed for Pacing Lesson Plan Instruction

Tests for the attainment of the end-of-course objectives were constructed as part of Step 6. Here the additional tests identified as needed in the immediately preceding substep must be constructed. These of course are concerned only with the subordinate tasks. Frequently, scores on the practice exercises used for training the tasks will provide sufficient information.

Summary, Step 7

The number of factors for the instructor to keep in mind in lesson planning are many. Good judgement is clearly not eliminated by the course design procedure but rather it is guided toward the significant. At this point in the procedure, the instructor will have a complete set of lesson plans based on his understanding of the lesson plan content and of learning principles. These lesson plans contain objectives that the procedure guarantees are job-oriented and realistic in terms of training capability; a complete outline of the instruction, including methods and needs for special materials; and finally the examinations needed to determine both the attainment of end-of-course objectives and to pace his instruction.

To get these the instructor has had to think about the subordinate tasks required to achieve his lesson plan objectives, incorporate most of them directly into his lesson plan content, select some for use as subordinate objectives, adjust the assignment of objectives to lesson plans, construct additional exercises needed, construct the examinations for pacing the instruction, and identify what is needed in the way of special materials. He is now ready to integrate these lesson plans, schedule the course and teach it, and on the basis of student attainment of the objectives, improve the course. These matters are the subject of the remaining steps in the course design procedure.

STEP 8. INTEGRATE LESSON PLANS WITHIN AND ACROSS INSTRUCTIONAL UNITS

With all lesson plans developed, they must be integrated in terms of the logic of the total course content and principles of learning. In addition to the logic of the subject matter, principles most pertinent are 3, 4, and 5 on pages 38 and 39, those concerned with spaced practice and review, interference and facilitation of learning by proper sequencing of similar and dissimilar tasks, and student motivation in terms of providing variety in the day's instruction. Their application is essentially the same as it was for individual lesson plans and need not be discussed further.

Once the integration of lesson plans is accomplished, the instructor can scan the adjusted lesson plans for convenient breaks for scheduling the course in calendar and clock hours. In scheduling the course, the instructor can get away from the constraints of the "50-minute hour," at least to the extent of scheduling so that the morning and afternoon are each scheduled for four "50-minute hours." Sometimes it is possible to make the entire day come out to the proper multiple of the "50-minute hour," while devoting times like 40 minutes, 100 minutes, etc., to specific lesson units. Deviation in the sequence of the logically integrated lesson plans should be avoided if at all possible. If the sequence has been proper, any deviation must reduce the efficiency of instruction to some extent.

STEP 9. CONDUCT COURSE AND EVALUATE ATTAINMENT OF END-OF-COURSE OBJECTIVES

Despite every effort, it is a rare course which attains all its objectives in its initial administration. Repeated conduct of the course is therefore part of course design; or to put it another way, course redesign or improvement is part of the course design process.

The key to improvement of the course is being able to determine from student attainment, or lack of attainment, of end-of-course and subordinate objectives where the problems of instruction are located. If all students attain an objective, the amount of instruction can be reduced on a trial basis. If all students still attain the objective, it can be reduced still more.

If a large proportion do not attain the objective, pertinent lesson plans should be examined to make sure all subordinate tasks are included, and instructional methods and time allotments examined to see what modifications should be made. The advantages of having tests of objectives which permit diagnosis of reasons for failure is apparent --a point that has been reiterated throughout this Manual. It is possible that the manner of testing for attainment is at fault although this possibility should be minimal if procedures in Steps 6 and 7 have been rigorously followed. The importance of this testing cannot be overemphasized in insuring continual improvement of course effectiveness and efficiency. This point is a powerful reason for careful thought in developing means of measuring student achievement.

From the above discussion, it is clear that from the instructor's point of view, the most important aspect of course evaluation is student success in the attainment of the end-of-course objectives. Three other common aspects of evaluating a course are: (1) validating the content, i.e., insuring that coverage of relevant material is complete and that no irrelevant material is included; (2) student critiques, and (3) follow-up studies of students' job performance. The first can be accomplished by following the method of course design described in this Manual. The third, while an essential part of a thorough evaluation program, is technically and practically an extremely difficult process; while it is not the concern of this Manual, the relevance of the discussion on pages 26 and 27 of the use of mock-ups for testing purposes should be clear.

Evaluation of students in a job-related training course is designed to determine whether they have attained the objectives, not to spread them out on a grading continuum in a "normal" (or other) distribution. The latter is done with tests for selection purposes--e.g., employment tests. It should not be done to evaluate training. Selection tests are designed to discriminate among people in order to separate those who are superior, average, and inferior. Training tests, since they are specific to the attainment of objectives, are designed to determine whether the students can perform certain tasks. If the student can perform the tasks, he has accomplished the objective; otherwise he needs additional training to accomplish it. The ideal to be sought in a training course is for all students to meet all objectives.

In the opinion of the writer of this Manual, students in a training course should not be graded in terms of any scale ranging from poor to excellent (or 1.0 to 4.0) but in simple pass-fail terms. If a student does the tasks in the end-of-course objectives considered essential for him to go on to the next course or directly to the duty assignment, he proceeds to his destination. If he does not, he should be retained in the course until he does, or his job assignment changed. There are many advantages to this philosophy, the most important of which is that the attitudes of both student and instructor change from concern over career impact of the grading system to a genuine concern over attainment of the objectives essential to performance on responsible Navy assignments.

This concept of an absolute rather than a relative grading system has important implications for the selection of items that comprise a training test which requires a representative sample of items. In aptitude and selection tests, items that do not discriminate among students (items are passed by nearly all students or items are failed by nearly all students) are generally eliminated from the test. However, in a training test, items passed by nearly all students would indicate those areas in which the instruction was good, and items failed by nearly all students would point to those areas where instruction was inadequate.[9]

In aptitude and selection tests, a "valid item is one which is passed by students who achieve a high score on the total test, and failed by those who score low on the entire test or in some external criterion. This interpretation of the term "validity" is not appropriate to training test items, which should indicate whether the student has or has not attained a specific objective.

In evaluating training it is also inappropriate to convert total scores on a training test to percentiles or "standard" scores, which are based on the performance of the average student. Although of some use in class to class comparisons, the group average gives no information on whether specific objectives have been attained. This group average is a relative rather than an absolute standard and itself is not a measure of the attainment of specific course objectives.

Student critiques should play a limited role in course evaluation. Used alone they can give a very misleading impression of the course and instructor effectiveness. Such critiques can only reflect student opinions about what was liked or disliked about instructor behavior or general procedures. The student is not likely to be knowledgable in the job for which he is being trained; nor has he gone through the task analysis step, nor does he always keep the course mission in mind when making his critique. Therefore he is not in a position to judge the relevance of the instruction to particular course missions and objectives. Student critiques can tell how well the student liked something and provide some insight into instructor behavior and into procedures that caused difficulties. Use of critiques with questions aimed at particular problems at particular times will probably yield better information than general critiques covering all aspects of a course. But judgments of instructor competence or course adequacy should never be made on the basis of critiques alone. In evaluating instructors, supervisors should place major reliance on analyses of tests of student performance in relation to objectives and minor reliance on any critiques that are collected. Even on the question of instructor mannerisms, direct observation by a supervisor is far to be preferred over student critiques.

STEP 10. IMPROVE THE COURSE

This step consists essentially of applying the results of the degree to which students have met the end-of-course objectives to the first nine steps of the procedure. If many students are failing to meet many of the objectives, perhaps the mission (Step 1) is too broad for the time allotment and one or the other must be changed. Perhaps gross job entry standards (Step 3) should be changed or the training in some tasks should be deferred to the job. End-of-course objectives (Step 6) may need to be changed, as may methods of instruction (Step 5) or the organization of lesson plans or time allotments within them (Step 7). Perhaps requirements for student entrance to the course should be raised. Step 10 then is essentially a feedback step (diagramed in Fig. 1) based on the information gained in Step 9. Good use of this feedback step for all Navy courses can result in a payoff that would be hard to match by any other single change of any kind in terms of resulting improvement, short of a breakthrough in a major weapons system; first in Navy training, and then in Navy operations. The role of tests in this step has already been sufficiently emphasized.

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[9] This discussion assumes that the test items are valid and clear expressions of the behaviors in the objectives.

A FINAL WORD

The reader who has persevered this far may be disheartened at the complexity of the course design and redesign process. There is no dodging the fact that it is a complex process, requiring bringing together not only job knowledge, but knowledge of how to develop a task inventory, learning principles and how to apply them, how to construct good tests, how to analyze the end-of-course tasks into the subordinate tasks to achieve the best sequence for learning, in addition to many common sense principles such as the requirement for a course mission that is realistic and sets clear boundaries to what the course is intended to achieve. On some of these matters, typical training instructors will need professional and technical training help. Navy training management will need to determine how this assistance can best (and least expensively) be provided. It is precisely because the problem of course design is complex that the payoff in accomplishing it systematically in accordance with the principles of this Manual can be so great.

A good instructor however will be heartened by the fact that the procedure includes many obvious principles which he can himself apply, e.g., training should provide for the possibility of adapting to individual differences in student experience.

There are many compensations for designing a course in the manner suggested in this Manual--among them the ease of subsequent maintenance and the assurance that a change in the course represents progress in the attainment of objectives. When one looks at the number of years some courses have been in existence and the number of hours spent organizing and reorganizing them without a thorough application of recently developed course design technology, he is not impressed by arguments that the time required to follow the systematic procedure described in this Manual is excessive. The difficulty of carrying out the procedure will of course vary with the complexity of the course. For a course concerned with a single task, e.g., sonar target classification, preparation of a certain report, etc., many of the complications discussed herein are avoided. The procedure however should still be followed systematically.

The reason that the maintenance of the course is simplified is that the on the job tasks stay nearly constant for most jobs. Additions or deletions to a list of task changes should be made only after surveying a number of job experienced people, and *never on the basis of the experience or opinion of a single person*. Anything else in the course may change, providing the change enhances the attainment of inventory task performance in terms of achieving greater levels of performance or in reducing the time necessary to achieve a particular task performance.

Thus far, the problem of course length has not been mentioned. Ideally, it should be the time it takes to achieve the objectives. Practically, this is rarely possible. What this method of course design does is permit conscious and intelligent selection of the objectives to be met within time restrictions. Such selection will, in the long run, result in better trained graduates than covering all objectives with reduced standards in "a once-over lightly" approach.

This Manual urges a systematic approach to course design. It should be clear to the reader that *systematic* does not mean *mechanical*. There is no substitute for informed judgment in course design. What the Manual has attempted to do is sharpen this judgment by making clear the number of factors that have to be taken into account and the critical points at which each should be exercised.

NOTE: FEEDBACK LOOPS ARE ON THE RIGHT. INTERACTION LOOPS ARE ON THE LEFT. BOXES ON THE LEFT ARE SUBSTEPS WITHIN A STEP.

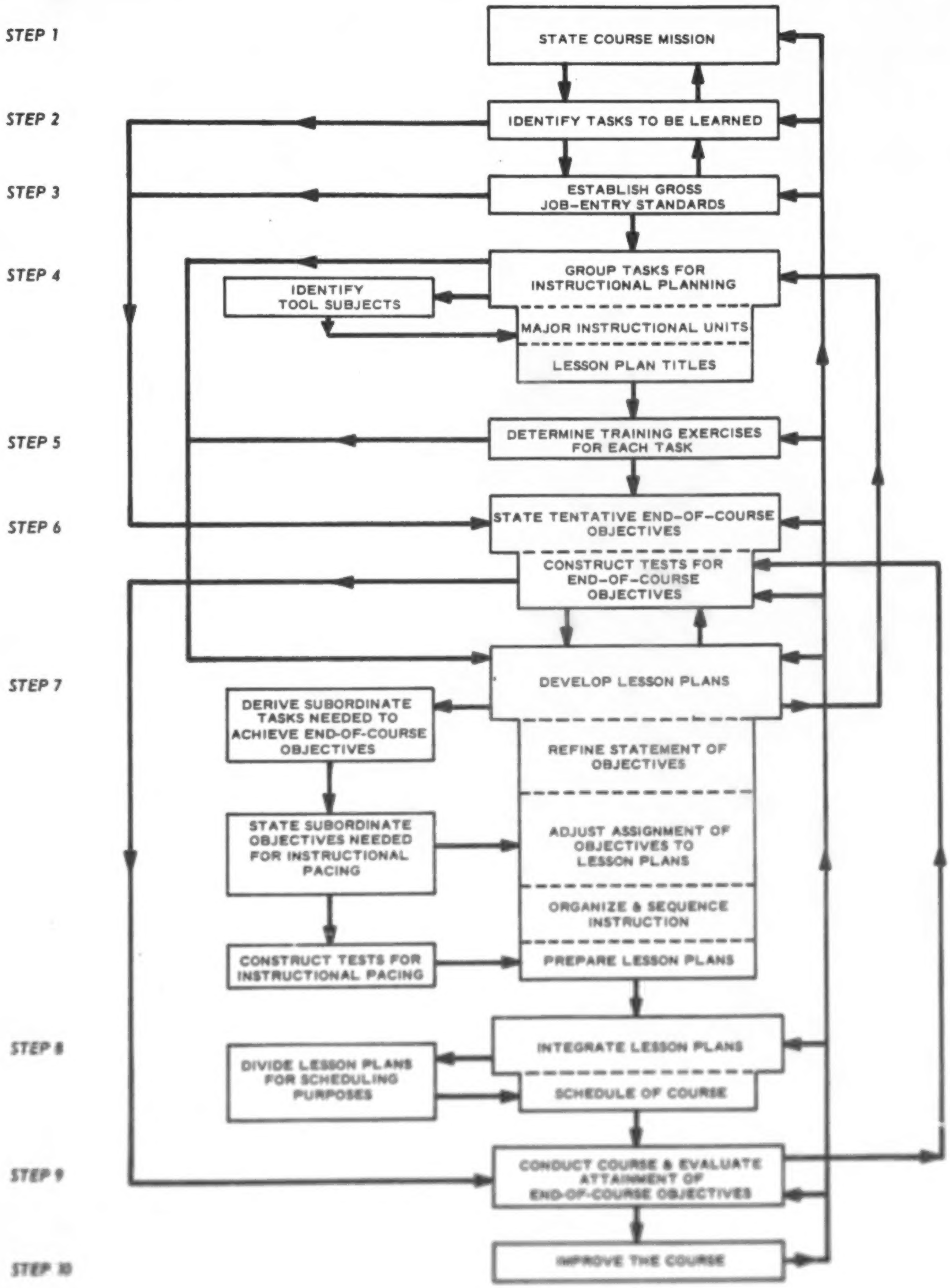
STEP 1
STATE COURSE MISSION
STEP 2
IDENTIFY TASKS TO BE LEARNED
STEP 3
ESTABLISH GROSS JOB-ENTRY STANDARDS
STEP 4
GROUP TASKS FOR INSTRUCTIONAL PLANNING
IDENTIFY TOOL SUBJECTS
MAJOR INSTRUCTIONAL UNITS
LESSON PLAN TITLES
STEP 5
DETERMINE TRAINING EXERCISES FOR EACH TASK
STEP 6
STATE TENTATIVE END-OF-COURSE OBJECTIVES
CONSTRUCT TESTS FOR END-OF-COURSE OBJECTIVES
STEP 7
DEVELOP LESSON PLANS
DERIVE SUBORDINATE TASKS NEEDED TO ACHIEVE END-OF-COURSE OBJECTIVES
REFINE STATEMENT OF OBJECTIVES
STATE SUBORDINATE OBJECTIVES NEEDED FOR INSTRUCTIONAL PACING
ADJUST ASSIGNMENT OF OBJECTIVES TO LESSON PLANS
ORGANIZE & SEQUENCE INSTRUCTION
CONSTRUCT TESTS FOR INSTRUCTIONAL PACING
PREPARE LESSON PLANS
STEP 8
INTEGRATE LESSON PLANS
DIVIDE LESSON PLANS FOR SCHEDULING PURPOSES
SCHEDULE OF COURSE
STEP 9
CONDUCT COURSE & EVALUATE ATTAINMENT OF END-OF-COURSE OBJECTIVES
STEP 10
IMPROVE THE COURSE

FIG. 1. TRAINING COURSE DESIGN SEQUENCE WITH MAJOR INTERACTION AND FEEDBACK LOOPS

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APPENDIX A

REVISED TASK INVENTORY

COMBAT INFORMATION CENTER WATCH OFFICER

Thomas E. Curran

1.0 PREPARATION FOR ASSUMING THE WATCH

1.1 Checking of stored data

1.1.1. Availability

1.1.1a Sights, using checklist if desired, stored data required to administer the watch, assuming custody for classified material.

1.1.2 Data Extraction

Determines information, events, and procedures applicable to his watch by reviewing:

1.1.2a pertinent operation orders

1.1.2b CO's Night Orders

1.1.2c pass-down-the-line (PDL) log

1.1.2d pertinent messages

1.1.3 Data Interpretation and Amplification

Amplifies and interprets data derived from operation orders, Night Orders, PDL log, and messages, by referring to:

1.1.3a doctrinal publications

1.1.3b fleet and ship standing operating procedures (SOP)

1.1.3c intelligence materials

1.2 Determination of system status

1.2.1 Status Boards and Plots

1.2.1a Determines presence, location, relative movement, and degree of threat of surface contacts by inspecting, interpreting, and evaluating data on surface summary plot.

1.2.1b Determines presence, location, relative movement, and degree of threat of air contacts by inspecting, interpreting, and evaluating data on air summary plot.

1.2.1c Determines information pertinent to radar and intercept search guards, EMCON, and current or anticipated intercepts by inspecting, interpreting, and evaluating data on electronic warfare status board.

1.2.1d Determines current communication organization and capability by inspecting, interpreting, and evaluating data on communication status board.

1.2.1e Determines operating status of all major equipment by inspecting equipment status board.

1.2.2 Equipment

Checks operating condition and adjustment of surface search radar,

1.2.2a determining if external controls are properly set for assigned function of equipment (e.g., long range surface guard, radar piloting) and for satisfactory scope presentation; and

1.2.2b adjusting or directing adjustment of, equipment as necessary.

Checks operating condition and adjustment of air search radar,

1.2.2c determining if external controls are properly set for assigned function of equipment (e.g., long range air guard, zenith search) and for satisfactory scope presentation; and

1.2.2d adjusting, or directing adjustment of, equipment as necessary.

Checks operating condition and adjustment of IFF equipment,

1.2.2e determining if external controls are properly set to ensure optimum accomplishment of equipment function; and

1.2.2f adjusting, or directing adjustment of, equipment as necessary.

Checks operating condition and adjustment of intercept search equipment,

1.2.2g determining if external controls are properly set for assigned function of equipment (e.g., band, antenna, and function controls) and for satisfactory scope presentations; and

1.2.2h adjusting, or directing adjustment of, equipment as necessary.

Checks operating condition and adjustment of radiotelephone equipment,

1.2.2i determining if external controls (e.g., volume, channel selector, patch panel) are properly set;

1.2.2j ensuring that communications are clearly established by radio check with other units in accordance with prescribed procedures; and

1.2.2k adjusting, or directing adjustment of, equipment as necessary.

Checks operating condition and adjustment of internal communication equipment,

1.2.2l ensuring that satisfactory connections are made at proper jackboxes and that equipment is operating properly; and

1.2.2m adjusting, or directing adjustment of, equipment as necessary.

Checks operating condition and adjustment of dead reckoning tracer (DRT) equipment,

1.2.2n determining if external controls (e.g., scales, on-off switches, latitude/longitude settings) are properly set for satisfactory operation; and

1.2.2o adjusting, or directing adjustment of, equipment as necessary.

1.2.3 Repair, Recording, and Reporting of Equipment Malfunctions

1.2.3a Requests assistance from appropriate technical personnel to correct equipment malfunctions beyond capability of watch personnel.

1.2.3b Informs cognizant administrative and operational personnel of nature of equipment malfunction, estimated time of repair, and effects on CIC capability.

1.2.3c Directs the timely and accurate posting and/or updating of information on equipment status board and entry of appropriate notations in equipment records for which CIC has responsibility.

1.2.4 Availability and Preparation of Personnel

1.2.4a Determines if number of personnel available for the watch is sufficient to carry out the mission of the system for the scheduled evolutions.

1.2.4b Interacts with CIC Officer or other appropriate authority to obtain additional personnel if required.

1.2.4c Determines if personnel are familiar with watch procedures and the functions they entail, interacting with CIC Watch Coordinator in briefing personnel.

1.3 Watch planning

1.3.1 Equipment

1.3.1a Determines, with assistance of CIC Watch Coordinator, which equipments will be used for what purpose, which stations will be manned, and which stations will perform two or more functions, by correlating requirements of guard and EMCON and time-sharing plans, evolutions to be carried out, and equipment and personnel available.

1.3.1b Determines procedures for implementing guards and EMCON and time-sharing plans, briefing watch personnel as required.

1.3.2 Personnel

1.3.2a Determines, with assistance of CIC Watch Coordinator, which personnel will perform required duties of watch.

1.3.2b Directs and monitors assignment of watch personnel to stations and subsequent rotation within stations by Watch Coordinator.

1.3.2c Directs and monitors on-the-job training of watch personnel by Watch Coordinator or other personnel assigned this task.

2.0 SURFACE OPERATIONS

2.1 Detection, identification, tracking, evaluating, and reporting of surface contacts

2.1.1 Surface Search Radar

2.1.1a Monitors surface search radar operator in search for and detection of surface contacts and processing, display, and reporting of contact data.

> NOTE: Operator must correctly adjust and manipulate radar repeater controls, estimate size and composition of contacts, plot their movements, determine closest points of approach, estimate courses and speeds, and correctly and completely make appropriate reports, while maintaining alert watch for new contacts.

2.1.1b Determines closest point of approach of surface contacts from radar plotting head.

2.1.1c Estimates course and speed of surface contacts from radar plotting head, plotting or visualizing relative motion of contact and correlating with own ship's true motion.

2.1.2 Intercept Search

2.1.2a Monitors intercept search operator in search for and detection of electronic emissions, and processing and reporting of intercept data.

> NOTE: Operator must correctly adjust and manipulate intercept search equipment controls, conduct analysis, DF, and evaluation of intercepts, and correctly and completely make appropriate reports, while maintaining alert watch for new intercepts in assigned guard band.

2.1.2b Evaluates intercepted signals rapidly as to type and function of emitter using general guidelines based on one or more major electronic characteristics.

2.1.2c Evaluates intercepted signals as to specific identity, function, origin, and capabilities and limitations using intelligence materials and all available electronic characteristics of emitter.

2.1.3 Radiotelephone

2.1.3a Monitors radiotelephone operators in receiving and processing incoming surface contact data.

NOTE: Operator must use correct procedures in receiving and receipting for data and in requesting clarifications, rapidly and accurately decode and/or interpret messages, and correctly pass to appropriate CIC stations.

2.1.3b Receives and receipts for incoming surface contact data when necessary, using correct procedures, standard equipment operation techniques, and proper authentication measures.

2.1.3c Decodes and interprets messages with the aid of signal books, doctrinal publications, and operation orders.

2.1.4 Sound Powered Telephone

2.1.4a Monitors sound powered telephone talkers in receiving and processing incoming surface contact data.

NOTE: Talkers must use correct sound powered telephone procedures in receiving and receipting for data and in requesting clarification, rapidly and accurately decode and/or interpret data if required, and correctly pass data to appropriate CIC stations.

2.1.5 Maneuvering Board

2.1.5a Monitors maneuvering board plotters in plotting and processing surface contact data.

NOTE: Plotters must correctly plot surface contact data specified by CICWO or ship's SOP, solve problems for course, speed, and closest point of approach, and correctly pass data to appropriate CIC stations.

2.1.5b Estimates rapidly the CPA of a surface contact, plotting or visualizing relative motion on maneuvering board.

2.1.5c Determines accurately the CPA of a surface contact on maneuvering board, performing all operations required for solution.

2.1.5d Estimates rapidly course and speed of a surface contact, plotting or visualizing relative motion on maneuvering board and correlating with own ship's true motion.

2.1.5e Determines accurately the course and speed of a surface contact on maneuvering board, performing all operations required for solution.

2.1.5f Estimates rapidly course and speed for own ship to avoid a surface contact by a specified distance in a specified direction, plotting or visualizing relative motion on maneuvering board, correlating with own ship's true motion, and adjusting relative motion line as required.

2.1.5g Determines accurately the course and speed for own ship to avoid a surface contact by a specified distance in a specified direction, performing all operations required for solution.

2.1.6 Dead Reckoning Tracer (DRT)

2.1.6a Monitors DRT operator in plotting and analysis of radar and ECM data on DRT.

NOTE: Operator must correctly adjust and manipulate DRT equipment, plot positions of radar contacts and lines of bearing of ECM intercepts, analyze and correlate radar plots and triangulated bearings, and correctly pass data to appropriate CIC stations.

2.1.6b Determines from DRT plot the course and speed of contacts based on radar positions and/or ECM triangulations plotted by DRT operator.

2.1.6c Evaluates DRT plot to determine Rules of the Road for a given contact situation, correlating own ship's course, target position, and target angle.

2.1.7 Surface Summary Plot

2.1.7a Monitors surface summary plotter in maintaining all required information up-to-date on surface summary plot.[10]

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[10] Due to the content-oriented nature of the surface summary plot, surface status board, and EW status board, which is well-documented in doctrine and SOP, it is not considered necessary to note special information pertaining to these tasks, as is normally done with "monitoring" tasks.

2.1.8 Surface Status Board

2.1.8a Monitors surface status board keeper in maintaining all required information up-to-date on surface status board.[10]

2.1.9 Electronic Warfare Status Board

2.1.9a Monitors EW status board keeper in maintaining all required information up-to-date on EW status board.[10]

2.1.10 Evaluation

2.1.10a Selects significant surface contact data for dissemination to various command levels.

> NOTE: Must inspect all available data in CIC pertaining to surface contacts, determine its reliability and significance with respect to tactical requirements, correlate it with information from stored sources, and select data in order of priority for dissemination.

2.1.10b Determines, when Rules of the Road situation exists, the type of situation and the status of own ship under the appropriate rules

2.1.10c Selects the appropriate whistle signals and/or maneuvers required of own ship for a given Rules of the Road situation.

2.1.11 Dissemination

2.1.11a Translates significant, evaluated data into appropriate format (coded or plain language) for dissemination.

2.1.11b Monitors sound powered telephone talkers in accurately transmitting significant, evaluated surface contact data to external shipboard stations.

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[10] Due to the content-oriented nature of the surface summary plot, surface status board, and EW status board, which is well-documented in doctrine and SOP, it is not considered necessary to note special information pertaining to these tasks, as is normally done with "monitoring" tasks.

NOTE: Talkers must use correct sound powered telephone procedures and adhere to pertinent ship's SOP.

2.1.11c Monitors radiotelephone operators in accurately transmitting significant, evaluated surface contact data to other units and commands.

NOTE: Operators must use correct and appropriate radiotelephone procedures, equipment operation techniques, and authentication measures.

2.1.11d Transmits significant, evaluated surface contact data to other units and commands when required, using correct procedures, standard equipment operation techniques, and proper authentication measures.

2.1.11e Transmits, in emergency situations, significant, evaluated surface contact data to other shipboard stations via multichannel circuit or ship's service telephone, using correct internal communications procedures and adhering to pertinent ship's SOP.

2.2 Maneuvering to and maintaining station in formations and screens.

2.2.1. Surface Search Radar

2.2.1a Monitors surface search radar operator in obtaining bearings and ranges to Guide and other force units and the processing, display, and reporting of radar data.

NOTE: Operator must correctly adjust and manipulate radar repeater controls, identify and label other force units on scope, plot relative movement, determine CPA's of other units passing in close proximity to own ship, and correctly and completely make appropriate reports.

2.2.1b Determines closest point of approach of other force units from radar plotting head.

2.2.1c Estimates course and speed of other force units from radar plotting head, plotting or visualizing relative motion of contact and correlating with own ship's true motion.

2.2.2 Radiotelephone

2.2.2a Monitors radiotelephone operators in receiving and processing incoming maneuvering data.

NOTE: Operator must use correct procedures in receiving and receipting for data and in requesting clarification, rapidly and accurately decode and/or interpret messages, and correctly pass data to appropriate CIC stations.

2.2.2b Receives and receipts for incoming maneuvering data when necessary, using correct radiotelephone procedures, standard equipment operation techniques, and proper authentication measures.

2.2.2c Decodes and interprets messages received via radiotelephone, with the aid of signal books, doctrinal publications, and operation orders.

2.2.3 Sound Powered Telephone

2.2.3a Monitors sound powered telephone talkers in receiving and processing incoming maneuvering data.

NOTE: Talkers must use correct sound powered telephone procedures in receiving and receipting for data and in requesting clarification, rapidly and accurately decode and/or interpret data if required, and correctly pass data to appropriate CIC stations.

2.2.4 Maneuvering Board

2.2.4a Monitors maneuvering board plotters in processing maneuvering data.

NOTE: Plotters must correctly plot positions of force units specified by CICWO or ship's SOP, solve problems for course and speed to station, time to arrive on station, and CPA of Guide and other force units, and correctly pass data to appropriate CIC stations.

2.2.4b Estimates rapidly the course and speed for own ship to station, plotting or visualizing desired relative motion on maneuvering board and correlating with Guide's true motion.

2.2.4c Determines accurately the course and speed for own ship to station on maneuvering board, performing all operations required for solution.

2.2.5 Dead Reckoning Tracer (DRT)

2.2.5a Monitors DRT operator in plotting and analyzing movements of Guide and other force units during formation and screen maneuvers.

NOTE: Operator must correctly adjust and manipulate DRT equipment, maintain an accurate track of Guide and other designated units, provide back-up data to maneuvering board for course and speed to station, and correctly pass data to appropriate CIC stations.

2.2.5b Determines course and speed of Guide and own ship's course and speed to station from plot maintained by DRT operator.

2.2.6 Surface Status Board

2.2.6a Monitors surface status board keeper in maintaining all required information up-to-date on status board.[10]

2.2.7 Formation Diagram

2.2.7a Monitors formation diagram keeper in maintaining all required information up-to-date on formation diagram.[10]

2.2.8 Evaluation

2.2.8a Selects significant maneuvering data for dissemination to various command levels.

NOTE: Must inspect all available data in CIC pertaining to formation and screen maneuvers, determine its reliability and significance with respect to tactical requirements, correlate it with information from stored sources, and select data in order of priority for dissemination.

2.2.8b Determines for recommendation to Ship Control, the actions required of own ship to complete the ordered maneuver.

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[10] Due to the content-oriented nature of the surface status board and formation diagram, which is well-documented in doctrine and SOP, it is not considered necessary to note special information pertaining to these tasks.

2.2.9 Dissemination

2.2.9a Translate significant, evaluated maneuvering data into appropriate format (code or plain language) for dissemination.

2.2.9b Monitors sound powered telephone talkers in accurately transmitting significant, evaluated maneuvering data to external shipboard stations.

NOTE: Talkers must use correct sound powered telephone procedures and adhere to pertinent ship's SOP.

2.2.9c Monitors radiotelephone operators in accurately transmitting significant, evaluated maneuvering data to other units and commands.

NOTE: Operators must use correct and appropriate radiotelephone procedures, equipment operation techniques, and authentication measures.

2.2.9d Transmits significant, evaluated maneuvering data to other units and commands when required, using correct procedures, standard equipment operation techniques, and proper authentication measures.

2.2.9e Transmits, in emergency situations, significant, evaluated maneuvering data to other shipboard stations via multichannel circuits or ship's service telephone, using correct internal communications procedures and adhering to pertinent ship's SOP.

2.3 Radar piloting and navigation

2.3.1 Surface Search Radar

2.3.1a Monitors surface search radar operator in obtaining bearings and ranges to navigational points during radar piloting, and in processing, display, and reporting of radar piloting data.

NOTE: Operator must correctly adjust and manipulate radar repeater controls, identify and label radar piloting points on scope, and correctly and completely make appropriate reports.

2.3.2 Sound Powered Telephone

2.3.2*a* Monitors sound powered telephone talkers in receiving and processing incoming radar piloting data.

NOTE: Talkers must use correct sound powered telephone procedures in receiving and receipting for data and in requesting clarification, and correctly pass data to appropriate CIC stations.

2.3.3 Dead Reckoning Tracer (DRT)

2.3.3*a* Monitors DRT operator in carrying out his duties during radar piloting or navigation.

NOTE: Operator must correctly adjust and manipulate DRT equipment (e.g., latitude and longitude scales, tracking scales), maintain accurate track of own ship on chart, plot and track specified contacts, compute set and drift and course and speed made good, and correctly pass data to appropriate CIC stations.

2.3.3*b* Determines from plot maintained by navigational plotter such information as set and drift, course and speed made good, times to turn, and turning bearings to visual or radar check points.

2.3.3*c* Checks new navigational positions when received from Navigator with information available on DRT or navigational plot, interacting with Navigator in assuring accuracy of fix.

2.3.4 Navigational Log

2.3.4*a* Monitors navigational log-keeper in legibly, accurately, and completely recording pertinent navigational data.[11]

2.3.5 Evaluation

2.3.5*a* Selects significant radar piloting/navigational data for dissemination to various command levels.

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[11] As with status boards, logs are also content-oriented, and require no amplifying data in the task inventory.

NOTE: Must inspect all available data in CIC pertaining to radar piloting or navigation, determine its reliability and significance with respect to tactical requirements, correlate it with information from stored sources and select data in order of priority for dissemination.

2.3.5b Determines, for recommendation to Ship Control, the actions required of own ship to maintain a safe navigational track.

2.3.6 Dissemination

2.3.6a Translates significant, evaluated data into appropriate format for dissemination.

2.3.6b Monitors sound powered telephone talkers in accurately transmitting significant, evaluated radar piloting or navigational data to external shipboard stations.

NOTE: Talkers must use correct sound powered telephone procedures and adhere to pertinent ship's SOP.

2.3.6c Transmits, in emergency situations, significant, evaluated radar piloting or navigational data to other shipboard stations via multi-channel circuit or ship's service telephone, using correct internal communication procedures and adhering to pertinent ship's SOP.

2.4 Man Overboard

2.4.1 Preparation

2.4.1a Interacts with CIC Watch Coordinator in maintaining CIC in alert posture for man overboard.

NOTE: Must ensure that DRT is uncluttered and available for immediate use and keep informed of wind and sea conditions to ensure prompt action in event of man overboard.

2.4.2 Dead Reckoning Tracer

2.4.2a Monitors DRT operator in carrying out man overboard procedures promptly and accurately when warning is received.

NOTE: Operator must set DRT to appropriate scale, plot estimated position of man in water and wind direction, and determine continuous ranges and bearings to man's estimated position.

2.4.3 Sound Powered Telephone

2.4.3a Monitors sound powered telephone talker in receiving and processing man overboard data from other stations.

NOTE: Talker must use correct sound powered telephone procedures in receiving and receipting for data and in requesting clarification, and accurately repeat data to appropriate CIC stations verbatim.

2.4.4 Evaluation

2.4.4a Selects significant man overboard information for dissemination to various command levels.

NOTE: Must inspect all available data in CIC pertaining to man overboard, determine its significance and reliability, and select data in order of priority for dissemination.

2.4.4b Determines, for recommendation to Ship Control, maneuvering actions and whistle signals based on CIC man overboard data.

2.4.5 Communications

2.4.5a Monitors sound powered telephone talkers in accurately transmitting significant, evaluated man overboard data to other stations.

NOTE: Talkers must use correct sound powered telephone procedures and adhere to pertinent ship's SOP.

2.4.5b Monitors radiotelephone operators in accurately transmitting to other units and commands significant, evaluated man overboard information.

NOTE: Operators must use correct and appropriate radiotelephone procedures, equipment operation techniques, and authentication measures (if required).

2.4.5c Transmits man overboard information to other units and commands via radiotelephone when necessary, using correct radiotelephone procedures, and standard equipment operation techniques.

2.4.5d Transmits, in emergency situations, man overboard data to other shipboard stations via multi-channel circuit or ship's service telephone, using correct internal communications procedures and adhering to pertinent ship's SOP.

3.0 ANTI-AIR OPERATIONS

3.1 Detection, identification, tracking, evaluating, and reporting of air contacts.

3.1.1 Air Search Radar

3.1.1a Monitors air search radar operator in search for and detection of air contacts and processing, display, and reporting of contact data.

NOTE: Operator must correctly adjust and manipulate radar repeater controls, estimate size and composition of contacts, plot their movement, determine closest point of approach and course and speed, and correctly and completely make appropriate reports, while maintaining alert watch for new contacts.

3.1.1b Determines course, speed, and closest point of approach of air contacts from radar plotting head.

3.1.2 Surface search (low flyer detection) radar

3.1.2a Monitors surface search (or other low flyer detection) radar operator in search for and detection of low flyers and processing, display, and reporting of contact data.

NOTE: Operator must correctly adjust and manipulate radar repeater controls, estimate size, composition, and altitude of low flyers, plot their movements, determine course, speed, and closest point of approach, and correctly and completely make appropriate reports, while maintaining alert watch for new contacts.

3.1.2b Determines course, speed, and closest point of approach of low flyers from radar plotting head.

3.1.3 Height Finding Radar

3.1.3a Monitors height finding radar operator in carrying out his assigned duties.

NOTE: Operator must correctly adjust and manipulate radar repeater controls in searching for contacts within a specified area or determining altitude of specified contacts, process contact data, and correctly and completely make appropriate reports, while maintaining alert watch for new contacts.

3.1.4 Intercept Search

3.1.4a Monitors intercept search operator in search for and detection of electronic emissions, and processing and reporting of intercept data.

NOTE: Operator must correctly adjust and manipulate equipment controls, conduct analysis, DF, and evaluation of intercepts, and correctly and completely make appropriate reports, while maintaining alert watch for new intercepts in assigned guard band.

3.1.4b Evaluates intercepted signals rapidly as to type and function of emitter using general guidelines based on one or more major electronic characteristics.

3.1.4c Evaluates intercepted signals as to specific identity, function, origin, and capabilities and limitations using intelligence materials and all available electronic characteristics of emitter.

3.1.5 Radiotelephone

3.1.5a Monitors radiotelephone operators in receiving and processing incoming air contact data.

NOTE: Operator must use correct procedures in receiving and receipting for data and in requesting clarifications, rapidly and accurately decode and/or interpret messages, and correctly pass data to appropriate CIC stations.

3.1.5b Receives and receipts for incoming air contact data when necessary, using correct procedures, standard equipment operation techniques, and proper authentication measures.

3.1.5c Decodes and interprets messages with the aid of signal books, doctrinal publications, and operation orders.

3.1.6 Sound Powered Telephone

3.1.6a Monitors sound powered telephone talkers in receiving and processing incoming air contact data.

NOTE: Talkers must use correct sound powered telephone procedures in receiving and receipting for data and in requesting clarifications, rapidly and accurately decode and/or interpret data if required, and correctly pass data to appropriate CIC stations.

3.1.7 Coordinate Systems

3.1.7a Monitors watch personnel engaged in conversion of bearings and ranges to appropriate coordinate systems.[12]

3.1.8 Air Summary Plot

3.1.8a Monitors air summary plotter in maintaining all required information up-to-date on plot.[12]

3.1.8b Monitors air status board (tote board) keeper in maintaining all required information up-to-date on board.[12]

3.1.9 Electronic Warfare Status Board

3.1.9a Monitors EW status board keeper in maintaining all required information up-to-date on board.[12]

3.1.10 Evaluation

3.1.10a Selects significant air contact data for dissemination to various command levels.

NOTE: Must inspect all available data in CIC pertaining to air contacts, determine its reliability and significance with respect to tactical requirements, correlate it with information from stored sources, and select data in order of priority for dissemination.

3.1.11 Air Intercept Control

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[12] No explanatory remarks required.

3.1.11a Interacts with Air Intercept Controller in exchange of data required by AIC (e.g., intercept orders, courses, speeds, or altitudes of targets) and that required to maintain status boards in CIC or to report to other stations (e.g., success of intercept, course and speed requirements for own ship).

3.1.12 Dissemination

3.1.12a Translates significant, evaluated data into appropriate format (coded or plain language) for dissemination.

3.1.12b Monitors sound powered telephone talkers in accurately transmitting significant, evaluated air contact or AIC data to external shipboard stations.

NOTE: Talker must use correct sound powered telephone procedures and adhere to pertinent ship's SOP.

3.1.12c Monitors radiotelephone operators in accurately transmitting significant, evaluated air contact or AIC data to other units and commands.

NOTE: Operator must use correct and appropriate radiotelephone procedures, equipment operation techniques, and authentication measures.

3.1.12d Transmits significant, evaluated air contact or AIC data to other units and commands when required, using correct radiotelephone procedures, standard equipment operation techniques, and proper authentication measures.

3.1.12e Transmits, in emergency situations, air contact or AIC data to other shipboard stations via multi-channel circuit or ship's service telephone, using correct internal communication procedures and adhering to pertinent ship's SOP.

3.1.13 Watch Turn-over

3.1.13a Interacts with CIC Watch Coordinator in assignment or relief of personnel in enlisted watch team without disruption of ongoing activities in the event that a higher condition of readiness is ordered.

3.1.13b Provides AAW Evaluator with all pertinent air contact data when he reports ready to relieve CICWO.

4.0 ANTI-SUBMARINE OPERATIONS

4.1 Detection, identification, tracking, evaluating, and reporting of submarine contacts

NOTE: This function presumes accomplishment of tasks in 2.1 (detection, identification, tracking, evaluating, and reporting of surface contacts) if a surface contact is subsequently evaluated as a possible surfaced or partially surfaced submarine.

4.1.1 Status and Preparation

4.1.1a Interacts with CIC Watch Coordinator to ensure that CIC maintains an alert posture for submarine contacts and that a minimal time ensues between receipt of initial submarine contact and preparedness to prosecute contacts.

4.1.1b Monitors CIC Watch personnel in the transition from normal watch procedures to ASW posture.

NOTE: CIC personnel must react rapidly when submarine contact is made, manning appropriate ASW stations (e.g., North DRT plotter, CI net), setting DRT to proper scale, and ensuring that correct communications links are established.

4.1.2 Surface Search Radar

4.1.2a Monitors surface search radar operator in detecting and processing submarine contacts.

NOTE: Operator must attempt to distinguish possible submarines on surface search radar, plot and determine course, speed, and CPA of such contacts when identified, and correctly pass data to appropriate CIC stations.

4.1.3 Radiotelephone

4.1.3a Monitors radiotelephone operator in receiving and processing incoming submarine contact data.

NOTE: Operator must use correct procedures in receiving and receipting for data and in requesting clarifications, rapidly and accurately decode and/or interpret messages, and correctly pass data to appropriate CIC stations.

4.1.3b Receives and receipts for incoming submarine contact data when necessary, using correct procedures, standard equipment operation techniques, and paper authentication measures (when directed).

4.1.3c Decodes and interprets messages with the aid of signal books, doctrinal publications, and operation orders.

4.1.4 Sound Powered Telephone

4.1.4a Monitors sound powered telephone talkers in receiving and processing incoming submarine contact data.

NOTE: Talkers must use correct sound powered telephone procedures in receiving and receipting for data and in requesting clarifications, rapidly decode and/or interpret data if required, and correctly pass data to appropriate CIC stations.

4.1.5 Dead Reckoning Tracer (DRT)

4.1.5a Monitors DRT operators in plotting and processing submarine contact data.

NOTE: Operators must correctly adjust and manipulate DRT equipment, plot positions of own ship, assist ship(s), and submarine contact on DRT, label and identify plots, and correctly pass data to appropriate CIC stations.

4.1.5b Determines from DRT plot maintained by DRT operators the course, speed and aspect of contact, evaluating situation as to classification, possible identity, and possible intentions.

4.1.6 Evaluation

4.1.6a Selects significant submarine contact data for dissemination to various command levels.

NOTE: Must inspect all available data in CIC pertaining to submarine contact, determine its reliability and significance with respect to tactical requirements, correlate it with information from stored sources, and select data in order of priority for dissemination.

4.1.6b Determines, for recommendation to Ship Control, appropriate maneuvers to place ship in position to conduct urgent attack.

4.1.7 Dissemination

4.1.7a Translates significant, evaluated information into appropriate format (coded or plain-language) for dissemination.

4.1.7b Monitors sound powered telephone talkers in accurately transmitting significant, evaluated submarine contact data to external shipboard stations.

NOTE: Talkers must use correct sound powered telephone procedures and adhere to pertinent ship's SOP.

4.1.7c Monitors radiotelephone operators in accurately transmitting significant, evaluated submarine contact data to other units and commands.

NOTE: Operators must use correct and appropriate radiotelephone procedures, equipment operation techniques, and authentication measures.

4.1.7d Transmits significant, evaluated submarine contact data to other units and commands when required, using correct radiotelephone procedures, standard equipment operation techniques, and proper authentication measures.

4.1.7e Transmits, in emergency situations, submarine contact data to other shipboard stations via multi-channel circuit or ship's service telephone, using correct internal communication procedures and adhering to pertinent ship's SOP.

4.1.8 Watch Turn-over

4.1.8a Interacts with CIC Watch Coordinator in assignment or relief of personnel in enlisted watch team without disruption of outgoing activities.

4.1.8b Provides ASW Evaluator with all pertinent submarine contact information when he reports ready to relieve CICWO.

APPENDIX B

ILLUSTRATIVE LESSON PLAN, CICWO COURSE

Thomas E. Curran

UNCLASSIFIED

OUTLINE AND SCHEDULE

1DEC 66

MONITORING CIC WATCH PERSONNEL

TIME			
ELAPSED	TOPIC		
10	10	INTRODUCTION:	
		PRESENTATION:	A. Equipment capabilities and limitations.
			B. Types and sources of surface contact data.
			C. Common errors in collection of surface contact data.
			D. Display and processing of radar data.
			E. Display and processing of intercept search data.
			F. Reporting procedures within CIC.
120	110		
		DEMONSTRATION:	A. Verbal reports and corresponding displayed data pertaining to surface contacts.
			1. Correct procedures
			2. Incorrect procedures
140	20		
		APPLICATION:	A. Detection of errors in verbal reports and corresponding displayed data.
260	120		1. Practice
300	40		2. Performance test

PERIODS: 6

1 DEC 66

UNIT: Detection, Identification, Tracking, Evaluating and Reporting of Surface Contacts

TITLE: MONITORING OF CIC PERSONNEL

DESIGNATOR: 207

OBJECTIVES:

A. End-of-course objectives:

1. Detects errors in data or procedure on the part of the following personnel, given representative samples of audio-taped verbal reports to and from these personnel and visual displays corresponding to those reports which are typical of a surface contact situation:

   Surface search radar operator (Task 2.1.1a: Monitors surface search radar operator in search for and detection of surface contacts and processing, display, and reporting of contact data)

   Intercept search operator (Task 2.1.2a: Monitors intercept search operator in search for and detection of electronic emissions and processing and reporting of intercept data)

   Maneuvering board plotter (Task 2.1.5a: Monitors maneuvering board plotter in plotting and processing surface contact data)

   DRT operator (Task 2.1.6a: Monitors DRT operator in plotting and analysis of radar and ECM data on DRT)

   Radiotelephone operator (Task 2.1.3a: Monitors [illegible]iotelephone operator in receiving and processing incoming surface contact data)

INTRODUCTION: A. Establish contact.

B. Build interest/show value.

1. The failure of even one man in CIC to properly carry out his assignment may disrupt the mission of the entire team.
2. The CICWO is responsible for proper functioning of CIC during normal steaming.
3. Therefore, the CICWO must ensure that each team member accomplishes his job in a timely manner with a minimum of error.
4. The CICWO, while he does not have to be an expert in each job in CIC, must know enough of those jobs to detect errors and to effect corrective action.
5. Every error the CICWO detects decreases the probability that the safety of the ship might be impaired or the operational effectiveness degraded.

C. Overview.

1. Review of previously learned material having a bearing on the monitoring function.
    - a. Equipment capabilities and limitations.
    - b. Types and sources of surface contact data.
    - c. Common errors in collection of surface contact data.
    - d. Display and processing of radar data.
    - e. Display and processing of intercept search data.
    - f. Reporting procedures within CIC.

2. Presentation of the manner in which two or more of the above factors tie together or hinge one upon the other in the monitoring function.
    a. Organization of the CIC.
    b. General purpose and content of ship's Standing Operating Procedure and the CIC Doctrine or SOP.
3. Practice exercises in which students will detect errors in data or procedure in audio-taped, simulated CIC surface contact situations.
    a. Questions and answers and class discussion following each short exercise.
4. Test exercise similar in construction and content to practice exercises in which student's ability to detect the errors will be evaluated.

ELAPSED TIME: 10'

PRESENTATION: A. Equipment capabilities and limitations.

Review........... 1. Surface search radar

Trans. 207-1 a. Capabilities:

(1) Other ships.

(2) Low flying aircraft.

(3) Land.

(4) Small water-borne objects.

Trans. 207-2 b. Limitations:

(1) Contacts at surface of water.

(2) Beyond theoretical maximum range.

(3) Inside theoretical minimum range.

(4) Very low-density contacts.

(5) Contacts near or over land.

Trans. 207-3 (6) Weather conditions.

(a) Abnormally long or short ranges.
(b) Rain squalls resembling surface contacts.

Trans. 207-4 (7) Range and bearing resolution limitations.

Review............ 2. Intercept search.

Trans 207-5 a. Capabilities:

(1) Long range early warning.

(2) Undetectable from external source.

(3) Analysis and evaluation may provide identification.

Trans. 207-6 b. Limitations:

(1) Contact must be radiating.

(2) Only certain frequencies.

(3) Mutual interference.

(4) Range and bearing.

ELAPSED TIME: 25' (5) Operator proficiency and complex maintenance.

Review......... B. Types and sources of surface contact data.

Trans. 207-7 1. Surface search radar.

a. Contact validity

b. Size and composition

c. Distance vs. threat

d. Relative motion (ahead/astern)

Trans. 207-8

2. Intercept search
    a. Signal validity
    b. Electronic characteristics
    c. Evaluation (type, function, etc.)
    d. Danger threat (type of scan, type of equipment, etc.)
    e. Bearing drift

Trans. 207-9

3. Radiotelephone
    a. Initial contact reports from other units radar or intercept search.
    b. Amplifying reports on contacts detected by other units.
    c. Amplifying reports on contacts detected by own unit (e.g., visual identification of own contact).
    d. Bearing reports for cross-bearing triangulation.

ELAPSED TIME: 35'

C. Common errors in the collection of surface contact data.

Trans. 207-10

1. Surface search radar
    a. Reporting weather as contact
    b. Reporting one contact as two or vice versa incorrectly.
    c. Reporting contact at 60 miles as ship under normal conditions.
    d. Failing to report contact in timely manner.
    e. Failing to report contact on collision course.

Question: Can anyone think of any other errors which may occur?

Trans. 207-11

2. Intercept search
    - a. Failing to report intercept in a timely manner.
    - b. Reporting one or more characteristics of intercept incorrectly.
    - c. Incorrectly making rapid evaluation of signal type and function.
    - d. Failing to properly search his assigned guard area.

Trans. 207-12

3. Radiotelephone
    - a. Relaying messages incorrectly or decoding messages inaccurately.
    - b. Unauthorized transmission.
    - c. Improper terminology or prowords on network.
    - d. Failure to report incoming data in timely manner or reporting it to improper station.

ELAPSED TIME: 50'

D. Display and processing of radar data.

1. Major displays:
    - a. Maneuvering board
    - b. Dead Reckoning Tracer
    - c. Radar repeater plotting head.
2. Others: (To be discussed in detail later)
    - a. Surface status board
    - b. Surface summary plot

Trans 207-13

3. Computation and display of CPA data.
    - a. Accuracy of solution.

- (1) Radar plotting head.
    - (a) Generally most accurate.
    - (b) Does not require transfer of data from one plot to another.
    - (c) Operator must take care in plotting and in constructing relative motion line.
    - (d) Cursor and strobe can be used to measure bearing and range.
- (2) Maneuvering board and DRT.
    - (a) Both reasonably accurate if
        - 1. Radar operator reports data accurately.
        - 2. Plotters plot data as accurately as possible.
    - (b) Both these provide plots only at intervals--radar plotting head provides good minute-by-minute check.

b. Speed of solution.

- (1) Radar usually the fastest means due to constantly updated picture.
    - (a) A certain amount of time is required regardless of method, depending on the degree of relative motion.
    - (b) May detract from operator's detection assignment.
    - (c) If contact load is heavy, operator may not have time to compute all CPA's.
- (2) Contrary to popular belief, DRT can be faster in solving for CPA than maneuvering board if operator is proficient.

(2) Both slower than radar--depend on radar for data.

Tans. 207-14

4. Computation and display of course and speed information.

    a. Accuracy of solution.

        (1) DRT most accurate.

            (a) No problem of using incorrect scale.
            (b) A change in course and/or speed of own ship requires no adjustment.
            (c) Does have an inherent error due to set, drift, advance and transfer.
            (d) DRT gives good TRUE picture of motion, helping in Rules of Road decision.

        (2) Maneuvering board accurate to within limits of plotting and scaling errors.

            (a) Plotter must use correct one of five possible scales.
            (b) If own course and/or speed changes, new vector must be plotted before solution.
            (c) Is not affected as greatly by set, drift, etc.
            (d) Provides good relative picture of motion.

        (3) Radar plotting head.

            (a) Good estimate of course and speed can be obtained--accuracy is possible but requires considerable time to achieve.

    b. Speed of solution.

(1) Proficient operator on DRT can solve for course, speed, and CPA as quickly as maneuvering board solves for CPA.

ELAPSED TIME: 75'

(2) Accurate solution faster on maneuvering board than plotting head.

Trans. 207-15 E. Display and processing of intercept search data.

1. DRT

a. Of limited value if the ship is steaming independently.

(1) May provide a rough "running fix" of contact via successive single bearings.
(2) A single bearing and an estimated range give general contact position.
(3) Useful mainly in evaluation of emitter and correlation with radar contacts.

b. When in company of other ships, two or more ships taking simultaneous bearings can fix position of contact.

(1) DRT operator must plot bearings and ranges of other ships from radar at time bearings are taken.
(2) Can then plot bearings from each ship as data is received.
(3) Successive cross-triangulations establish rough course and speed of contact.

c. Cross-triangulation is time-consuming and requires strict coordination.

(1) This is seldom used for surface contacts and virtually never used for air contacts.

ELAPSED TIME: 80'

F. Reporting procedures within CIC.

1. Differ greatly from ship to ship and from one type ship to another.
2. Primary requirements: brevity and completeness with a minimum of noise level.
3. Radar reports

Trans. 207-16

- a. Initial contact
    - (1) Preface report with "SURFACE CONTACT" or "RADAR CONTACT" to alert other personnel.
    - (2) Include at least bearing and range.
        - (a) Bearings always in three digits.
        - (b) Range usually in yards.
    - (3) CPA may be included under some conditions.
        - (a) If contact load permits immediate computation.
        - (b) If contact is some distance from force.

Trans. 207-17

- b. Subsequent reports
    - (1) Preface with contact designation.
        - (a) For example, "SKUNK BRAVO BEARS ......"
    - (2) Initiates when new information is available or when directed by CICWO or ship's SOP.
    - (3) Be alert to report bearing and range immediately when plotter gives "MARK, SKUNK BRAVO."
        - (a) Usually preceded a few seconds by "STAND BY, SKUNK ..."

4. Intercept search reports

Trans 207-18	a. Initial contact (1) Use essentially the same procedures used for reporting intercepts to external stations. (2) Alert other personnel by indicating a new intercept. (3) Include at least frequency, bearing, and time in initial report. (4) Include other characteristics if immediately available.
Trans 207-19	b. Subsequent reports (1) Preface with intercept designation. (a) For example, "RACKET ONE BEARS....." (2) Initiate when new information is available or when directed by CICWO or ship's SOP. (3) Operator be alert to report bearing immediately when given "MARK, RACKET......" (2) Normally preceded a few seconds by "STAND BY..."
Handout 207-1	5. Reports from plotters a. Procedures differ from ship to ship based on ship's SOP.
Cover main headings of handout.	b. Handout offers one possible SOP plotters' reports.
	c. If ship's SOP does not cover an existing situation, CICWO should direct action to be taken.
Trans. 207-20	d. Major considerations: (1) Timely reports of solutions of course, speed, and CPA. (2) Accuracy of course, speed, and

CPA should be ensured by reports from two sources; one can then be checked against the other.

(3) Data from plotters must be sent to appropriate stations needing that information.

(4) Plotters should get as much from their plots as possible; often such things as contact course and speed changes, Rules of the Road situations, and threats of danger can be ascertained.

ELAPSED TIME: 120'

DEMONSTRATION: A. Verbal reports and corresponding displays pertaining to surface contacts.

1. CORRECT displays and reports

Stress................ a. This ten-minute series of reports and displays is CORRECT in every detail.

(1) Note format and terminology of reports.

(2) Note neatness and accuracy of displays.

b. Tape consists of reports from radar, maneuvering board, DRT, intercept search, and radiotelephone.

(1) Reports pertain to detection and processing of from one to three contacts.

(2) Note how back-up information is provided for course, speed, and CPA.

3. Displays consist of pictures of radar scope, maneuvering board, and DRT at critical points during contact processing.

Exercise D-1.
Instructor starts tape.
Runs continuously to end.

Displays will appear on screen automatically on cue from tape.

When complete, instructor points out salient features, answers questions, and invites comment.

2. INCORRECT reports and displays

Stress............... a. This ten-minute series of reports and displays contains a number of typical errors.

(1) Each of you should try to detect each error which occurs.

(2) Note particularly errors in data, mistakes in computing course, speed, and CPA as seen on displays, and failure of personnel to provide back-up information.

b. Content of exercise will be identical to previous one, with the exception that ten major errors are programmed into the taped reports and five into displays.

Exercise D-2.
Instructor start tape.
Runs continuously to end.

Displays appear automatically on cue from tape.

When completed, instructor points out each error and answers questions.

ELAPSED
TIME:
140'

APPLICATION: A. Detection of errors.

1. Practice

a. Run number 1

(1) Ten-minute tape consisting of reports from radar, maneuvering board, and DRT only.
(2) Five displays of radar scope, maneuvering board, or DRT.
(3) Ten errors programmed into both the taped reports and the displays.
(4) Anyone detecting an error raise your hand, the tape will be stopped, and the error discussed.

Any questions????????

Exercise P-1
Start tape; stop when student raises hand.

At end, point out any errors not detected and answer questions.

b. Run number 2.

(1) Exercise is very similar to run number 1, except two intercept search reports and two radiotelephone reports are added.

Data sheet 207-1

(2) Students make note of errors detected on data sheet provided; tape will run continuously to completion.

Any questions??????????

Exercise P-2.
Instructor start tape; run to completion.

At end, each student in turn asked to identify and explain an error detected in exercise.

Instructor point out any errors not detected and answer questions.

c. Run number 3.

(1) Fifteen minutes exercise of similar content to first two but more difficult.

Data sheet 207-2

(2) Students again take notes on errors detected; tape will run continuously to completion.

Any questions???????

Exercise P-3
Instructor start tape; run to completion.

At end, each student in turn asked to identify and explain an error detected in exercise.

Instructor point out any errors not detected and answer questions.

ELAPSED
TIME:
260'

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2. Performance testing.

a. Content and procedure

(1) Two runs of fifteen minutes each, with the same testing procedures for both.

(2) Same general content as in practice exercises; errors constitute a representative sample of all errors in the practice runs.

Answer sheet 207-1......

(3) On answer sheet 207-1, student identify the time of each error detected and the reason it was an error.

(4) On first run we will exchange answer sheets and score at once; on second run, instructor will score.

b. Run number 1.[13]

(1) Fifteen minutes, with five displays.
(2) Ten errors in tape; five errors in displays.

Any questions???????
Exercise T-1
Start tape; run continuously to completion.

At end, exchange papers and instructor identify all errors.

c. Run number 2.[13]

(1) Fifteen minutes, with ten displays.
(2) Twelve errors in tape; eight errors in displays.
(3) Somewhat more difficult than previous run.

Any questions??????????

Exercise T-2
Start tape; run continuously to completion.

Collect papers for scoring after class.

Conduct class discussion and answer questions.

ELAPSED
TIME:
300'

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[13] Quantitative standards not yet established for these tests.

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13. ABSTRACT

This report, now called a First Edition, is a thorough revision of the Preliminary Edition of the Manual designed to assist instructors in designing and redesigning job-related training courses. The design and redesign process is now explicated in 10 steps with suggestions for accomplishing each. Major changes from the First Edition concern a criterion for stating on-the-job tasks which simplifies the design process, greater emphasis on the role of tests in the feedback loop, a new point of view on the statement of objectives, and a general clarification of the steps in the design and redesign process.

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